A-2312

FINAL REPORT

Research Project A–2312

Contract No. 125

STATE SCIENCE, ENGINEERING, AND TECHNOLOGY PROGRAM

GEORGIA

Prepared for

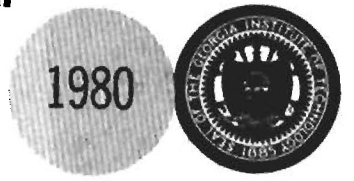
OFFICE OF THE GOVERNOR

February 1980

GEORGIA INSTITUTE OF TECHNOLOGY

Engineering Experiment Station

Atlanta, Georgia 30332



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EXECUTIVE SUMMARY

The State Science, Engineering, and Technology Program (SSET) has the ultimate goal of improving the working relationships between the Chief Executive and existing or potential scientific and technological resources. The Georgia SSET project was conducted through the joint efforts of the governmental, university, and private sectors within the state. The project was conducted in two major parts. The first part was directed to an analysis of potential SET mechanisms to determine the factors essential for a successful plan. This work involved examining and evaluating the past and present situation in Georgia and reviewing successful and unsuccessful mechanisms in other states. Criteria for success was identified and a plan for Georgia was conceived. The second part of the project served to develop and refine the plan and initiate its implementation.

An entity which would broaden the SET base by developing an advanced technology complex within the State of Georgia was identified as an element which could serve to strengthen the existing SET system. The Governor utilizes a central management system centered around the Office of Planning and Budget, but, at the same time, has very close informal working relationships with both the University System and industry. The ideal solution for providing better SET policy input is to improve and strengthen the present system and take advantage of the strong ties within the state which already exist.

In an effort to develop the optimal plan for such an entity in Georgia, literature searches were conducted, first-hand visits to various high technology centers were made, and interviews with key figures were conducted. A proposal for an Advanced Technology Development Service was developed and a detailed economic impact study was performed. The SSET project has continued with the initiation of implementation efforts.

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INTRODUCTION

SSET PURPOSE

The efficient utilization of scientific and technical resources, realized through the coordinated efforts of the appropriate groups is of prime importance in determining the potential for future advancement of quality of life. A framework of communication is necessary to provide interface among the governmental, university, and private sectors, based on their mutual interests in progress. A response to this need is the State Science, Engineering, and Technology Program (SSET), whose ultimate goal is to improve the working relationships between the Chief Executive and existing or potential scientific and technological resources.

SSET PROJECT TEAM

The Georgia SSET project was conducted through the joint efforts of the governmental, university, and private sectors within the state. The Office of Planning and Budget (OPB) within the Georgia Governor's Office served as the governmental representative in the project and coordinated the overall SSET effort. OPB performs advisory, functional, and liaison duties by providing staff for the Governor to handle budgeting, planning, intergovernmental relations, and internal auditing. The Office of Planning and Budget played an important role in the SSET project by identifying and examining the present science, engineering, and technological (SET) mechanism used by the Governor. As an integral part of that mechanism, itself, OPB possessed the ability to explore and evaluate the operation of the mechanism from the inside out. OPB also provided valuable input on the economic implications of the ultimately proposed SSET plan. Through these efforts, the Governor's Office demonstrated its interest in the development of a workable SET mechanism and its willingness to participate in the implementation of such a mechanism.

The primary participant in the SSET project from the university sector was the Georgia Institute of Technology, a national leader in technological research and instruction. Georgia Tech served to conduct the SSET project through its Office of the Vice-President for Research. Input came from academic (instructional) elements of the Institute, particularly, the College of Industrial Management and the schools of Electrical Engineering and Industrial Engineering; as well as from the Engineering Experiment Station.

The private sector was represented in this project by various groups and individuals, most significantly, the Committee of Twenty and the Atlanta Economic Development Corporation (AEDC). The role of the private sector was most important since it comprises a significant portion of the support essential to the successful implementation of the proposed plan. The Committee of Twenty is an alumni group composed of community leaders from the ten most recent Georgia Tech graduating classes. The involvement of the Committee stemmed from work done on one of the organization's own undertakings, the Technology Business Development project (TBD). The goal of the TBD is to increase Georgia Tech's service to the State of Georgia and the business community by utilizing Tech's resources to aid and expand high technology businesses in Georgia. The Atlanta Economic Development Corporation, a private, non-profit, corporation designed to promote the economic development of the city of Atlanta, also played an active role representing the position and perspectives of the private sector. The AEDC, in touch with the broad picture economic development, played an important role in assuring the compatibility the proposed SSET plan with the overall scheme for advancement in the Atlanta a.

PLAN DEVELOPMENT

The project team, by soliciting input from the major sectors within the State orgia, endeavored to provide a plan for the efficient utilization of the

scientific, engineering, and technological resources within the state. The SSET project was conducted in two major parts. The first part involved an analysis of candidate SET mechanisms to determine the factors essential for a successful plan. This work was conducted during the first two quarters of the project and involved examining and evaluating the past and present situation in Georgia and successful and unsuccessful mechanisms in other states. Criteria for success were identified and a plan for improvement was conceived. The second part of the project, conducted during the third and fourth quarters, served to develop and refine the plan and initiate its implementation.

PART I

INTRODUCTION

Part I is an extensive analysis of the ideology of an SET mechanism. The objective of this analysis was to determine those factors essential to providing the capability for the efficient utilization of SET resources in Executive policy development. Work involved reviewing the state's past efforts, examining existing mechanisms, evaluating the efforts of other states, identifying major gaps between present and potential utilization, and establishing a plan to fill those gaps. Available literature was reviewed, interviews were conducted, criteria were identified, and a plan for improvement was conceived.

A. PAST EFFORTS IN GEORGIA

The first step in the execution of the SSET project for the executive branch of Georgia was to investigate the past efforts made by the Governor's Office to more effectively involve science and technology in policy-making. This was accomplished by reviewing the available literature as well as by interviewing key state officials, including Norman Underwood, Past Executive Secretary; Gordon Harrison, Office of Planning and Budget staff for physical sciences; and Mark Zwecker, Director, Office of Energy Resources. This research into the historical aspect of science and technology usage in the State of Georgia produced the following information:

1. Research Priorities Study

Under the administration of Governor Jimmy Carter, the Goals for Georgia program was carried out in order to identify down-to-earth state-wide goals. An important step in the implementation of this program was the Georgia Research Priorities study which was performed by the Governor's Science Advisory Council under the direction of the Science Advisor. It was completed in 1973 and had as its purpose the following goal:

To determine the institutional arrangements needed to assure:

a. that the most critical state problems are addressed by the Georgia research community, and

b. that pertinent results are made available on a timely basis to governmental decision-makers.

This study recognized the fact that although many problems facing the state are primarily political, social, or economic in nature, many can be solved with science and technology. The study was initiated, therefore, to help the state better utilize its available resources and it did this with the following specific objectives:

- To identify the priority needs of Georgia in view of significant governmental and societal problems that lend themselves to resolution through research or the application of science and technology.
- To inventory past and on-going research and to determine what research should be performed to meet the highest priority needs of Georgia.
- To create a mechanism for bringing state-supported research to bear on critical state and local problems.
- To inform the research community of the key state problems, encouraging the direction of pertinent facets of research programs toward solving these problems.

The Governor's "Goals for Georgia" program identified areas of need under eight major program headings. The Research Priorities Study then established a priority ranking of those needs and identified the top three priority needs in each major program area that require concentrated research efforts. This was followed by an inventory of existing and planned research being conducted in the top priority need areas, along with recommendations for additional research that would contribute significantly to fulfilling the identified needs. This model for problem-solving is outlined in the following five steps:

1. Establish clear cut goals.
2. Rank goals in order of priority
3. Study and identify potential means for achieving the goals.
4. Determine the technical, political, and economic feasibility of the alternative methods of goal achievement.
5. Implement those potential solutions which are technically, economically, and politically feasible and for which resources are available. The study recommended that this model be repeated on an annual basis.

The key to its success was believed to be the establishment of a focal point in state government with the following characteristics:

- Continued contact with the Governor and state legislature.
- Full support of the Governor and state legislature.
- A well-defined responsibility for developing and utilizing the scientific and technical resources within the state.
- Direct access, formally or informally, to all science resources within the state - state agencies, local government, universities, industry and organizations such as the State Academy of Science.
- A problem-solving orientation rather than a research-for-the-sake-of research orientation.

2. Science Advisor and Science Advisory Council

The focal point necessary for insuring the success of the Research Priorities Study program was set up within the Office of the Governor in the form of the Science Advisor to the Governor and the supporting Governor's Science Advisory council. This focal point served to pull together the resources and people needed to conduct the Georgia Research Priorities study, but was consequently eliminated under the present administration in favor of a central management system.

3. Cataloging of Resources

One of the tasks as outlined by the Research Priorities Study was the

inventory of on-going research that was related to the identified areas of need. This inventory was accomplished by a mail survey of the research community in Georgia in which 255 survey forms were mailed out and 148 were returned. Of those responding, 76 listed applicable research and 58% of that research was reported by the university sector. The study recommended that this inventory be repeated on an annual basis, however, the succeeding administration developed a SET mechanism to fit its own organizational mode and chose, therefore, not to follow the recommendation.

B. PRESENT SITUATION IN GEORGIA

An examination of the mechanism which is presently being utilized by the Governor was the next step in the SSET project. Interviews with key state officials was the main source of information for this phase of the study. These interviews provided not only factual data on the past and present mechanisms, but they also aided in forming subjective evaluations of these mechanisms. Advantages and disadvantages were discussed along with suggestions and ideas for improvement. The SET mechanism which exists in Georgia at present is a central management system and is described below:

Existing SET Mechanism

By the various efforts which have been made in the past, it is clear that the importance of providing scientific and technological information to state policy makers has long been recognized in Georgia. The present system has proven to those involved with it that it will work well. The system centers around the Office of Planning and Budget which is the principal state agency for coordinating the planning and programming for comprehensive development. By performing advisory, functional, and liaison duties, OPB provides staffing for the Governor in budget, planning, intergovernmental relations, and internal auditing. It serves as the liaison with federal, state, and local sectors of government. With regard to public policy analysis

and program priority determination, the Office provides general research capability to the Governor. Often acting as the liaison structure between the potential policy advisors such as the University System, other sectors of government, and industry, OPB reviews and considers immediate and long-range state agency proposals, goals, and directions. OPB staff apprise the Governor of activities in their respective functional areas. The staff gathers information from research, personal contacts, work in the field, or departmental personnel. The office often works with various state departments to recommend state-wide goals and policies to the Governor for his decision.

Another source from which the Governor draws information is directly from the state governmental departments. Made up of both technical and policy-orientated personnel well versed in their respective areas, each department is headed by a commissioner who serves as a direct communication channel to the Governor. The departments work both in coordination with OPB as well as independently of OPB.

Outside of the government offices, the Governor has links with many scientific and technological sources. One of the major sources is the University System which provides a wealth of knowledge in many areas from which the Governor can and does draw. Georgia is fortunate and somewhat unique to have Georgia Tech, a state-funded major technological institute located in the heart of the state's capital city, Atlanta. This is an invaluable resource for information on science and engineering related problems including areas such as nuclear technology, waste water treatment, energy conservation, and alternate energy systems. Also located in Atlanta is Emory University which conducts research predominately related to the life sciences and includes work in radiation biology, cancer research, and ecology.

One other important university which is located in close proximity to the Capital is Georgia State University. Well known for its graduate business administration program, this is an important source of information on economic, commerce, and trade issues as well as geological matters. For most agricultural-related issues,

the Governor turns to the University of Georgia. Also found here is valuable information on water, mineral, and forest resources. There are many other universities which complete this sector of scientific and technological sources. The important point, however, is that the University System as a whole is an extremely valuable source of information from which the Governor frequently draws.

Hundreds of people, agencies, and organizations are continually making themselves available to the Governor as scientific and technological resources. These public interest groups and individuals might communicate directly with the Governor, or they may work with a department head, with department staff, or with OPB. Through whichever channel of communication they use, they are always an important source of information.

The primary objective of the existing system is to allow the Governor both a formal network for information through staff and departmental personnel as well as an informal network comprised of university and business contacts. The merit of this is to have communication flowing from several sources offering a variety of opinions from which the Governor can formulate judgements.

C. SET MECHANISMS IN OTHER STATES

The SSET final reports which are completed have been reviewed to examine the efforts made in other states to integrate SET information into the policy-making process of the Executive Office. Three of these reports have been summarized below:

1. IOWA

The Iowa final report identified three steps to any attempt to deliver SET information to policy makers and these are the following:

1) define the problem or question

2) answer the question scientifically or state alternative solutions

3) render the question and answer in terms useful to decision-makers

To perform these steps, the SSET group proposed an SET information system based almost entirely on the existing advisory network. This system includes the Governor's

Science Advisory Council (GSAC) which was established in 1977 by Executive Order and which is supported in its liaison functions through the office of the Governor's Science Advisor. The Council is composed of three panels under the general headings of energy, environment, and resources and there are four members on each panel. The purpose of the group is to make available, on a voluntary basis, vital SET information and advice. Members are appointed by the Governor for two-year terms and the Council is structured so that it does not require formal or scheduled meetings. Another valuable source of SET information are the state agencies, which served as the chief source of input prior to the appointment of the GSAC. The Iowa Academy of Science is another important organization which, although it is only peripherally related to state government, provides a network that interfaces with the scientific and engineering community across the entire state.

One of the work program tasks in Iowa's SSET project was to compile a directory of scientists and engineers who would be willing to serve on task forces or study committees if called upon by the GSAC. Refinement of the system is necessary which would require additional funding along with yearly updating of the inventory.

The Iowa report identified successful information systems to be those which are an integral part of the policy-making process. This condition insures that the information produced pertains to specific issues that are being considered. The report also concluded that a voluntary science advisory group can function effectively and recommended that the GSAC continue to operate as the principal mechanism for SET information with the Governor's Science Advisor as a member and liaison to the Governor. It was also recommended that a Roster of Scientific and Technical Resource Persons be maintained and updated regularly.

2. OKLAHOMA

The Oklahoma SSET project examined the type and extent of need for SET formation by the Governor and by agency policy makers. The resources available meet these needs were then inventoried and possible mechanisms for linking the

resources to needs were considered. The final report recommended the integration of a structured SSET Advisory Program in an Executive Branch Central Management Program format. State agencies and departments were investigated to determine the best candidate to serve as an organizational base for the SSET Advisory Program.

It was decided that the organizational base should provide a strategic location within the Executive Branch of the state government, a means for implementation of SSET Advisory Program recommendations and proposals, continuity of the program during administration changes, SET informational transfer among all relevant organizations, and policy input at the highest levels of the state government's Executive Branch. The SSET steering committee made their recommendations to the Governor and he approved in concept the establishment of the proposed program and designated the Department of Community Affairs (DECA) as the organizational base. As the Oklahoma report states, "DECA staff currently coordinate acquisition of SET information on a routine basis through its mandated state planning functions. Another of its functions is to coordinate local government planning in cooperation with substate planning districts...At the state government level DECA staff coordinates with numerous state agencies and university system organizations." The choice of DECA, then provides existing channels of communication for SET information flow and capitalizes on DECA's intergovernmental and intra-agency relationships.

3. SOUTH CAROLINA

The South Carolina report set forth criteria for an SET mechanism, reviewed past efforts to incorporate SET information in the gubernatorial decision-making process, and examined some examples of mechanisms in other states. The end of the project fell at a time when a new governor was taking office so an SET mechanism was not recommended. It was decided, however, to make an in-depth review of a SET mechanism in the energy field which resulted in a study of the Energy Research Institute (ERI). It is generally agreed by state officials that the ERI would be significant value to the state by directly solving energy problems and also by

simply existing as a successful center of scientific and technical excellence. To take advantage of its potential to assist the state government, it must be able to anticipate problems and to develop proper capabilities.

The Energy Research Institute was constituted in May, 1977, by Executive Order of Governor James Edwards to coordinate and intensify energy research within the state. Now it is a private, non-profit corporation chartered under the laws of the state. This study was conducted to determine under what circumstances and conditions the ERI could be expected to meet the original objectives. A successful ERI would benefit the state economically as well as technically. Funding could be supplied from the federal government, the state government, private industry, and general commercial organizations, but, a mechanism must be devised to provide such funding. The ERI should work with colleges and universities to take advantage of assistance by professors, graduate students, equipment, and facilities, while the universities take advantage of expanded research, financial support, extra income for faculty, and more attractive faculty positions. The ERI is seen as the starting point of a major research, development, and high technology manufacturing complex.

The following obstacles to a successful ERI were identified:

1) South Carolina's universities suffer in comparison to the U. S. average of the size of technical graduate schools, number of doctoral candidates, number of baccalaureate degrees granted, and the amount of ongoing research.
2) Major national corporations mainly consist of branch operations in the state while their R & D is performed elsewhere.
3) There are relatively few recognized engineers and scientists in the state.
4) There are many nuclear plants located in South Carolina, but they have little R & D capability.
5) The two largest electric utilities operating in the state are headquartered and have their central research and engineering staff in North Carolina. The financial potential for fund-raising is not large.

The favorable factors were also identified and are listed below:

1) The ERI has been established and has some ongoing contracts.
2) The scarcity of technical strength in the state should provide both a need for ERI and an incentive for success.
3) The ERI is backed by the Governor and a strong Board of Directors.
4) The need and available funding exists for R & D in energy.
5) The University of South Carolina is strong in geology which could be an area of expansion to create other centers of excellence.

The South Carolina SSET report concluded with the following recommendations:

1) A 3-5 year plan should be prepared including a survey to gather information on potential contracts, personnel requirements, and areas of interest to formulate a more sharply focused organizational and operational plan.
2) Expand the ERI staff, equipment and facilities only when the base load will clearly exist for an extended period of time. In the interim, subcontracting can fill the gap.
3) Develop funding plans.
4) Stress highest quality performance on early contracts.
5) Top quality staff is expensive but essential to obtain proposals and carry out the projects.
6) Maintain close liaison with appropriate state government units, colleges, and universities.
7) Emphasize industrial organizations as potential customers as well as participants in projects.

D. ANALYSIS OF NGA MODELS

The National Governor's Association (NGA) has identified six distinct models of mechanisms for incorporating science, engineering, and technological (SET) information into the executive branch policy-making process. These models include the

central management agency, science advisor, science advisory council, office of science and technology, concentration upon a specific functional area, and reliance upon the state university system. According to NGA, all of the models require the following steps to work successfully:

1) Identify those issues, problems, or questions to which science and technology are particularly relevant. This requires input from a source aware of important policy discussions, such as the Governor or an advisor upon whom the Governor regularly relies.
2) Frame the key questions for use by the scientific or technical community.
3) Transmit the question to the appropriate SET resource for analysis.
4) Transmit the analysis back to the policy makers in a form which they can utilize.
5) Allow for feedback and interaction.

Many different versions and combinations of the six models have been tried throughout all the states. Some have been successful; others have not. The success of the mechanism is not dependent so much on the type mechanism used, as there are successful and unsuccessful examples of each. Success, instead, hinges on the compatibility of the mechanism with the state's current situation. The mechanism must, therefore, meet two major criteria. It must first be able to meet the needs of the state, and secondly, it must fit into the organizational plan of the current administration. The mechanism for technology transfer, therefore, is not a static situation, but is defined by dynamic conditions. As changes take place in the needs of the state or in the administration, the SET mechanism must be adaptable to those changes or it will not survive. The ideal situation would be the existence of a mechanism which could adapt to the ever-changing environment around it.

The Georgia SSET project team has identified the following criteria as necessary

for the success of any type SET mechanism:

1) Availability to the Governor
2) Support by the Governor
3) Foresight
4) SET resource accessibility
5) Research capability and responsiveness to stated policies
6) Short response time
7) Incorporation into the Governor's decision making process
8) Continuity from one administration to the next

E. ANALYSIS OF GEORGIA'S SET MECHANISM

The State of Georgia has utilized different types of SET mechanisms. Governor Jimmy Carter utilized a Science Advisor along with a formal Science Advisory Council. The succeeding administration chose to replace these with a central management system.

The present administration feels that the formal approach involving a Science Advisor and Council tends to inhibit formal and informal communication flow. The present system emphasizes staff and university personnel in direct access to the Governor. This provides for a more satisfactory relationship with outside contacts than there would be if these contacts had to communicate through an intermediary person or council. The present system tends to eliminate the risk of creating bias toward a particular viewpoint, a danger that exists when one individual coordinates SET input. This system also allows for input from any sources within the technical community. Another advantage of this system is the fact that it is incorporated nto the policy-making apparatus providing, of course, availability to and support f the Governor. Such close coordination with the Governor provides the mechanism th foresight because the people involved are aware of important policy discussions. s system also allows a quick response time and is fairly continuous from one inistration to the next.

As with any system, this one has its drawbacks. The lack of formal coordination of communication with SET resources can be a hinderance to obtaining the best information possible. Some good resources in the state may not be utilized, while those that are utilized, may have become known through chance. In the past, the Governor has interfaced with particular sources of science and technology while dealing with one situation, and these sources later proved to be valuable in dealing with other issues. Many contacts for the state are made through travel and business, but are later lost when the administration changes. The lack of in-depth research capability is also a disadvantage of this system. Once a problem has been identified, obtaining funding to conduct research can require a great deal of time. To respond to problems quickly, therefore, a mechanism should be developed which could allow for the funding of research on short notice as called for by the needs of the state.

One solution to a more structured utilization of SET resources is the compilation of these resources into a directory. This was one of the recommendations of the Iowa SSET final report, but it was admitted that this work would require additional funding and yearly updating. This concept is one to consider; however, it does not seem to offer the ideal solution to the problem. It is possible that the funding which it would require could be put to better use by the State of Georgia. Interviews with state officials indicated that people, agencies, and organizations who are engaged in science and technology and who are aware of the problems facing state leaders tend to make themselves known. Letters are continually being received from people offering to help or apprise the Governor on issues of science and technology.

F. A SOLUTION FOR IMPROVEMENT

Georgia has a somewhat unique situation in that the Governor has close working relationships with both the University System and industry. This relationship supplements the formal access that the Governor has to information through staff and departmental personnel by providing an informal network comprised of university

and business contacts. An ideal SET mechanism is believed to be one which would further build upon and expand these already-strong ties. The project team became convinced after study that the way to achieve this is by developing a broad SET resource base in the state capable of providing scientific and technological input to the Governor.

The team recognized that the development of a viable mechanism for involving science, engineering and technology in policy formulation is a long range problem and will be encountered by succeeding administrations. Immediate steps such as the creation of a science advisor position or a science advisory board are short-term solutions to a long-range problem. Such solutions, then, were not viewed as appropriate by the state policy makers or by the research team. Rather, all parties decided informally that a judicious course of action was to concentrate on creating a climate condusive to continued involvement of the SET community in policy formulation and to build foundation structures which would accomplish long range objectives. A mechanism was sought, then, capable of advancing currently perceived near-term benefits of SET resource utilization, as well as, capable of developing a basis for continued SET input.

The creation of a component that has the potential for achieving this has demanded the attention of this SSET project team and possesses the potential to develop a complex of new, advanced technology industries. Serving as a ready liaison point to the Chief Executive, this entity would have the capability of producing policy options, would provide the necessary factors for the application of technological innovations both inside and outside the state government, and would have a very positive impact on economic development.

Similar to the concept of the Energy Research Institute as proposed by the South Carolina SSET report, this component could be of significant value by existing as a center for scientific and technical research and development. As the Iowa report states, successful systems are those which are an integral part of the policy-making

process; therefore, this component should be integrated in some manner into the executive branch of the state government. The Oklahoma report recommends a central management system similar to that currently existing in Georgia which provides existing channels of communication for SET information flow and which capitalizes on intergovernmental and intra-agency relationships. The proposed technology development component should also take advantage of the positive aspects of the existing system. This component would, then, serve to improve a system which is generally agreed upon by those involved with it, to be a system which has many strong points.

The marriage of the existing central management system and an advanced technology development component would provide great potential for meeting the criteria set forth earlier as necessary for the success of any SET mechanism. It would also meet two important objectives which are believed to be necessary for effective SET resource utilization: the component would serve not only to advise policy makers in the state on SET-orientated issues, but it also would possess the capability to develop and apply science and technology in solving the problems facing industry and government. The resulting expanded base of technical expertise would provide more and better SET input to the Chief Executive.

G. RECOMMENDATIONS

An entity which would serve as a technological center and simultaneously build a base of advanced technology industries in Georgia was identified as an element which could serve to strengthen the existing SET information system. The Governor utilizes a central management system centered around the Office of Planning and Budget. The situation in Georgia is unique, however, in that the Governor has very close working relationships with both the University System and industry and has a strong interest in having technology oriented economic development occur. The ideal solution for providing better SET input, is to improve and strengthen the

present system of communication and to take advantage of input from an expanded technology base.

A structure which would attract and stimulate advanced technology industries has many merits. Among the following are that it would:

1) Possess the capability of producing policy options
2) Promote technological innovativeness
3) Apply technology developed by the University System
4) Spawn new industry
5) Increase industrial productivity
6) Enhance Georgia as a good location for industry
7) Further economic development through job creation, sales, business tax revenue, and domestic and foreign investment
8) Promote social, cultural, and educational advancement

It was recommended by state leaders that the organizational and operational structure of such an entity be studied and developed as a major part of the remaining SSET project effort. Other, similar high technology centers should be examined and evaluated, and the factors which attributed to their success should be identified. The feasibility of such a component should, then, be studied by identifying the sources of expertise which Georgia has to offer to advanced technology firms or entrepreneurs and the potential utilization of such expertise by the Chief Executive.

PART II

INTRODUCTION

Part II of the SSET project has sought to conduct an extensive examination of centers of advanced technology industries. The primary objective was the ultimate development of an organizational and operational plan for an entity which would serve to create a center of high technology in the State of Georgia. Literature searches were conducted, visits to various high technology centers were made, interviews of key figures were conducted, a proposal for an Advanced Technology Development Service was written and refined by policy makers, a detailed economic impact study was completed, and implementation efforts were initiated.

A. ADVANCED TECHNOLOGY INDUSTRY

Advancements in technology play a major role in determining competitive and advantageous positions on national and international markets, and, at the same time, represent the means for the future progress in the efficient allocation of resources. Clearly the race for technology is a race for superiority, and innovation remains firmly entrenched as the lifeline determining economic status and growth. The promise for such progress lies in high technology firms which have been responsible for many signigicant innovative contributions. Typically, high technology firms emphasize research while concentrating on the development and utilization of new technology.

It has been observed in the U. S. that given the appropriate environment, major complexes of technologically based business can arise out of technological universities. The Research Triangle Park is one such example where an intellectually rich atmosphere prevails. In addition to the government agencies and industrial firms that are located within the Park's boundaries, many high technology manufacturers have located in North Carolina to take advantage of the Park's scientific

community. Such an environment also provides for the improved diffusion and application of technology developed by the universities which conduct large research activities. Further examples include Palo Alto, the area surrounding Stanford University; Carnegie-Mellon University in Pittsburgh; and the Route 128 complex in the Boston area.

In addition to serving as a valuable source of SET information, these centers of technologically based firms are desirable for the two reasons that they stimulate economic development and they promote innovativeness.

B. NATIONAL GOAL OF INNOVATION

Growth of advanced technology firms helps to meet the national goal of stimulating innovation. As Stuart Eizenstat, the President's Chief Advisor on domestic policy, stated, "Industrial innovation is central to the economic well-being of the United States. Innovation provides a basis for economic growth and is thus intimately related to productivity, to inflation, to unemployment, and to the competitiveness of U.S. products both in domestic and world markets. Efforts to enhance or improve innovation activity therefore may lead to an improved economic posture in the United States."[1] This statement was made as Eizenstat initiated the process for developing a federal policy on Industrial Innovation. This development of a federal policy on innovation underscores the seriousness of the problem of the decline in innovativeness in U.S. industry that has occurred in the past decade.[2]

C. ECONOMIC BENEFITS

The presence of technology based industry also affords substantial economic benefits to the region where it is located. The chief measure of impact is the number of jobs created as a result of the firms operating there. A 1967 report by the Technical Advisory Board of the U.S. Department of Commerce states that the rate of sales growth and job creation occurs more rapidly in innovative high

technology companies than in more mature organizations.[3] Such a growth in employment encompasses jobs of those directly related to the R&D activities of the firm, jobs of those working on the results of research, and indirect employment.

New jobs translate into increased demand for consumer goods and the creation of new investment opportunities, which together increase the capacity of the economy to raise productivity, thus achieving the multiplier effect. It should also be noted that advanced technology companies necessitate highly skilled professionals which will accordingly be accompanied by the appropriate level of salaries essential to attract this class of employees. This can have the effect of changing patterns of demand for consumer goods and services which in turn will most likely result in a rise in the local wage structure and per capita income.

Other beneficial economic aspects of high technology companies have been articulated by economists Edwin Mansfield and Michael Boretsky. They have published econometric data indicating that the return on investment in technological innovation measured in terms of economic growth, exceeds that achieved from most other stimulators, such as capital investment in plant and equipment.[4]

The economic effects of advanced technology industry are far-reaching and long-range. The technology based firm often creates a highly fertile climate for effective research and development. This acts as a catalyst which enlarges the potential of a region for further development and, at the same time, enhances the ability of the area to attract new industry.

D. A CENTER OF ADVANCED TECHNOLOGY IN GEORGIA

Georgia could benefit greatly from the development of a center of high technology industry. New innovations spawn new industry and provide the opportunity

to increase industrial productivity, which could put Georgia industries in a position of new leadership. Through this, Georgia will be enhanced as a desirable location for industry, making it attractive to firms looking to expand or relocate their operations and also to entrepreneurs looking for a good location to get started. With these economic advantages come social and cultural advancement as well. Most importantly, the creation of an advanced technology complex would expand the existing SET resource base and provide a broader range of SET input to the Governor. This would produce a climate condusive to continued involvement of the SET community in policy formulation and problem solving.

It is believed that the University System of Georgia and, in particular, the Georgia Institute of Technology, which is located in the state's capital, provides the starting point for such a venture. The advantages afforded by a high technology, university-affiliated center would be economically beneficial to the State of Georgia as well as consistent with the national interest of stimulating innovation.

In addition to this, such a center would improve the quality of the academic standing of the University System through increased national and international recognition, enhanced attraction of faculty and students, improved graduate programs, and enlarged graduate student populations.

E. A FIRST-HAND LOOK AT ADVANCED TECHNOLOGY CENTERS

In view of the successful development of high technology communities, and the desire of the SSET project team to introduce a component that would attract new, clean advanced technology industry to Georgia, a first-hand study was conducted in an effort to define the general framework necessary for the establishment of such a component and the means to secure its success. This analysis considered two areas of the nation densely populated with industries of an advanced technology nature.

Two SSET project team members visited the Los Angeles and Palo Alto areas in order to gain first-hand information from sources considered to be critical to the establishment and success of an advanced technology community. These sources include technical university personnel, advanced technology entrepreneurs, and members of the venture capital community. During their visit the project members were able to assess the factors that were unique to each situation, the specific role of the area universities, the problems that have arisen and the current state of the areas' industries. This experience allowed the project members to view the situation in Georgia against these successful examples, to make comparisons as well as contrasts, and, therefore, define strengths and weaknesses of Georgia's own scenario. The purpose of the comparisons was to build a very general foundation to review past efforts and results and to proceed toward devising an appropriate plan for Georgia. A summary of the information which was gained as a result of this trip follows. A detailed description of the interviews conducted is included in Appendix I.

Four factors were identified which were critical in the growth of advanced technology industry around Stanford and are the following:

1) Research work at Stanford University - Palo Alto is considered the birthplace of electronics and research at Stanford University included pioneering work in nuclear magnetic resonance, high power Klystron development, and high voltage x-ray generation with linear accelerators.

2) Working relationship between university personnel and the private sector - A strong communication channel existed between the research personnel at Stanford and many Stanford graduates and was the vehicle needed to bring about the commercialization of university research.

3) Lack of jobs for technically educated community - There was not a great demand for engineers in the area around Stanford in the thirties. Stanford graduates, therefore, were forced to leave the area or start their own companies.

4) Frederick Terman's determination and leadership - Dr. Terman, former provost of Stanford, sought to prevent the loss of so many Stanford graduates to other parts of the country. He did this by encouraging the start of new businesses in the area through programs such as the establishment of the Stanford Industrial Park.

Today, the high cost of living, the many restrictions set by the Stanford Industrial Park, and the general lack of new industrial space are factors which are causing many companies to look elsewhere for new plant locations. The Park places strict building limitations on the tenants. Structures are limited to two stories and the maximum land coverage ratio is very low. Housing costs are extremely high in the Palo Alto area and no effort has been made to provide reasonably-priced housing. This forces many employees to commute long distances and makes employee recruiting very difficult.

Hewlett-Packard (H-P) and Varian Associates both conduct research at their manufacturing plants which generally requires technically trained personnel with masters and/or doctorate degrees. Therefore, access to a technological university for advanced degree work opportunities is important in selecting plant sites. Georgia would be an ideal location for a new H-P or Varian plant because the videobased instructional system at Tech makes it possible for people all over the state to earn a graduate engineering degree from Tech. This is an advantage to companies in recruiting employees. Hughes Aircraft Corporation, as a matter of fact, utilizes this type of set-up with U.S.C. and advertises the fact to aid recruiting students. The Honors Cooperative Program at Stanford is another recruiting aid. It allows a company to guarantee acceptance in graduate school at Stanford to a prospective employee who has met certain qualifications.

H-P recently selected the Research Triangle over Atlanta as the location for a new plant because of the visible supportive relationship between the universities and industry. This supportive relationship between the RTI universities and industry was emphasized by RTI representatives on various visits which they made to H-P to discuss the possible location of an H-P plant in North Carolina.

This location of an H-P plant in an already-developing high technology industry center leads to a "critical mass" theory which predicts exponential growth for an advanced technology complex. It is expected that the growth rate will be slow initially until the critical mass of industry is reached. At that point other industry will be attracted by the existing industry due partly to the highly visible relationship between the university and industry. In addition to this, supply industries will be formed or will move to the area and spin-off companies will emerge from the existing companies.

It is expected that such a growth in high technology industry with its need for graduate study opportunities will result in an increase in the graduate programs at Tech. This was the case at Stanford. The engineering graduate students out-number the undergraduate students today, although this was not the :ase in previous years.

Precedents for programs to develop advanced technology complexes have been set other universities. The Industrial Engineering Department at Stanford has a gram to offer management aid to small technology businesses. The University Southern California offers courses designed to educate potential entrepreneurs. is done by offering a program in Entrepreneur and Venture Management as part Masters of Business Administration degree. U.S.C. and U.C.L.A. both have rial Associate Programs which provide many benefits to industry members such ulting privileges with faculty, publications of university research programs, ory equipment and facilities usage, library privileges, and graduate

recruitment assistance. Membership in the Industrial Associate Program is obtained by donating funds to the School of Engineering. This provides the School access to funds without going through the long budgeting process.

University personnel, successful entrepreneurs, and venture capitalists all agreed that a critical factor in the development of a high technology community is the availability of capital. Reid Anderson, founder of Verbatim Corporation as well as several other companies, identified space, money, and legal services as essential for entrepreneurs. Robert White in the Electrical Engineering Department at Stanford discussed the advisory role that faculty members play as technical consultants for the venture capital community. Ed Ginzton, Chairman of the Board for Varian, Associates, recommended liberal patent and consulting policies for faculty members in order to stimulate entrepreneur activities.

Members of the venture capital community which were interviewed recommended the involvement of local people in the venture capital effort. Venture capital firms are not geographically restricted, but because they are often involved in the management of the companies in which they invest, they prefer to invest in a restricted geographical area. It is important, therefore, to develop a local venture capital community. In addition to this, the banking community should be educated so that it could give direction to entrepreneurs who approach it seeking capital.

Venture capital firms have different investment policies. One which was interviewed set a minimum investment amount at $100,000 while another preferred not to invest less than $300,000. Reid Anderson, however, discussed Exxon Development Corporation which will invest a small amount of money for prototype development. After evaluation of the prototype, a large amount of money may be invested. California and Wisconsin were mentioned as two states which use money

through state-backed tax-exempt bonds to aid new and young businesses.

F. LITERATURE SEARCH

An extensive literature search and study was conducted regarding the high technology complex phenomenon, and the most recent findings and theories regarding its implementation, effects, and ramifications. The mere quantity of literature suggests that the question of high technology is of paramount interest to the growth of the nation as well as to that of the regions where it might be located. It is being addressed by factions of the government, academics and industry leaders nationwide. Findings resulting from this study were incorporated throughout this report and provided the project team with a foundation of knowledge from which to draw in formulating the SSET plan to build an advanced technology complex in Georgia.

G. ADVANCED TECHNOLOGY DEVELOPMENT SERVICE PROPOSAL

In response to the objective of creating an expanded SET base in Georgia, a proposal was formulated to establish the Advanced Technology Development Service (ATDS). It is felt that this can be accomplished most effectively by using the resources of Georgia Tech as a catalyst. The ATDS will focus simultaneously on various aspects of the matter directing attention to:

1) Development of an advanced technology entrepreneur community
2) Recruitment of domestic and foreign advanced technology companies
3) Assistance to existing Georgia industry for expansion into high technology product lines
4) Development of industries that can produce alternative energy products
5) Education of students, businessmen, and bankers in high technology venture development and management.

These programs are interrelated and mutually supportive. Each was selected because of its direct value to the high technology development success. A descrip-

tion of each element, the funding requirements, and the management plan are included below. The complete proposal for the Advanced Technology Development Service that was submitted to the Governor for review is found in Appendix II.

1. Advanced Technology Entrepreneur Development

In the overall development process, the role of the entrepreneur cannot be overlooked with advanced technology being proven to be the resevoir from which many major firms have been formed during the past thirty to forty years. These firms in turn have been the spawning ground for many other small firms building on the local technology base that has developed.

Technology is not the only ingredient that is necessary for innovation and growth, however. Local capital is essential and can be provided through bank and venture institutions if a reliable technical resource offers consulting assistance in technical areas. Georgia Tech represents that force and will use its resources to stimulate private capital expenditures in local entrepreneurial activity and will work to educate the local private capital community regarding high technology investment opportunities.

In order to address the small high technology business opportunity adequately it is proposed that an entrepreneurial assistance program be established which will accomplish the following:

(a) help entrepreneurs identify product markets,

(b) assist entrepreneurs locate venture capital and assist venture capitalists locate and evaluate entrepreneurial opportunities,

(c) assist entrepreneurs establish businesses and business plans,

(d) provide low cost space and access to specialized resources and equipment on the Tech campus.

This element is anticipated to require $40,000 for fiscal year 1981.

Incubator Space and Facilities Access

One major deterrent to entrepreneurial development today is access to

sophisticated test equipment and appropriately outfitted facilities. To overcome this barrier a facility will be provided to support high technology firms during their early formative years and will act essentially as an "incubator." After the firm grows to a healthy level it will be encouraged to locate outside of the incubator but still near Georgia Tech. This space will have the basic amenities and will be directed to basic support of chemical, mechanical, and electrical product development.

The incubator space will be provided in a general purpose building to be constructed contiguous to the Georgia Tech campus. This building will include 90,000 square feet of space on three floors. The ground (first) floor will be open bay type construction with a modular partition system capable of being subdivided into 2500 square foot modules. The second and third floors will be conventional office space.

Entrepreneurs can benefit in several ways from being located in the incubator space contiguous to Georgia Tech. This allows access to facilities on campus such as the computer center, the library, and specialized labs. More importantly, perhaps, the entrepreneur could benefit from the people at Georgia Tech. This includes faculty members who can play important roles as consultants. A location proximate to Tech also provides a source of motivated and technically trained part-time help in the form of graduate students. Students could conveniently work part-time for a company in the incubator facility while pursuing a graduate degree at Tech.

Incubator Facility Financing. In order to be responsive to the needs of private firms it is proposed that the construction of the incubator building be financed with private sector funds, and federal and state government funds. Efforts will be made to form a consortium of the Georgia Tech Research Institute (GTRI), Atlanta Economic Development Corporation, the State Office of Planning and Budget, and the U.S. Department of Commerce to raise construction funds. GTRI will be

asked to provide a cash match of up to $250,000 to be used to acquire a grant from the U.S. DOC through the Economic Development Administration. The grant applicant would be the Atlanta Economic Development Corporation and the Office of Planning and Budget. Land for the building would be provided by the AEDC from urban redevelopment sources. Title of the land and building would revert to GTRI. Management will be provided by Georgia Tech.

2. Advanced Technology Industrial Recruitement

In addition to entrepreneurial development a second important method for improving our industrial base is through the more traditional industrial development activities of recruiting high technology companies to our area, estimated to require $50,000 for fiscal year 1981. Higher technology industrial candidates considering relocation to our area are becoming much more sensitive to the technology support climate and must see a positive effort to meet their special needs. In an effort to do this, Georgia Tech would create a team of full-time professionals who would interface with domestic and foreign advanced technology industrial candidates.

As an added element, Georgia Tech would encourage high technology firms to locate R&D teams developing new products in the "incubator" building mentioned above. Proprietary research would be protected, but contract involvement of Georgia Tech faculty and staff would be encouraged. After product development has occurred, the pilot development and manufacturing operations would be encouraged to locate in Georgia and continuing interaction with Georgia Tech would be assured.

3. Aid to Existing Georgia Industry in Developing New High Technology Products

In addition to the effort to build technologically-based industry, a component of the Advanced Technology Development Service will be to stimulate the development of advanced technology product lines in existing companies. Such a course of action is important since approximately 70% to 80% of new jobs created are a result

of the expansion of existing industries. Funding is requested at the level of $50,000 for fiscal year 1981.

Although there is a broad program of aid to existing industry, it is primarily aimed at providing assistance to small and medium-sized companies, which are mostly labor-intensive. The expertise and assistance required for the proposed effort to aid and stimulate investment in production of high technology products differs from this traditional thrust, and will cover a wide range of management and technical assistance. Efforts will be directed toward identifying common technological problems and solutions, as well as specific individual problems.

The identification of Georgia natural resources and development of commercial applications for those resources could be another important aspect of this element. Disseminating the research findings from this work could be done through short courses and seminars as well as through the Georgia Tech Research Institue technology transfer magazine. A periodic publication of on-going university research could also be advantageous to industry and would serve to promote the commercialization of univeristy research results.

4. New Technologies for Alternative Energy Supplies

In the development of other areas of high technology industry concentration, specific technologies have usually been involved. Georgia tech research is especially strong in alternative energy technologies, especially solar thermal and biomass conversion. With the worsening world prospects for fossil energy supplies, these alternatives are becoming much more important and with careful treatment might provide the basis for a high technology industrial system in Georgia.

In order to address this emerging possibility it is proposed that a systematic program be established to encourage advanced alternative energy businesses to be created and use the incubator facility described above. Funding requirements are estimated at $30,000 for fiscal year 1981.

As support to this effort it is proposed that a core team of Georgia Tech faculty and staff be selected to identify near term markets, assess market potential and economic constraints, and to assist entrepreneurs develop business plans to take advantage of these opportunities.

5. Education and New Technology Development

Associated with the main goals of the Advanced Technology Development Service are certain educational needs and opportunities. This program element requiring $40,000 addresses the key issue of providing technology firm managers and students preparing for careers in technology management with the tools and training to better perform their jobs. Described below are several specific issues which will be addressed by this element.

Technology Update

In order to provide a perspective on the prominent areas of technological development, it would be appropriate to conduct periodic short courses which constitute a "technology update". The purpose would be to provide a greater consciousness, among the entire community, of technological development and more specifically to provide directly relevant background and information for institutions and individuals who might have a role in the ATDS.

Courses in Entrepreneurship

It would be appropriate to develop short courses in entrepreneurship under the auspices of the ATDS. The primary focus, of course, would be starting new businesses in the area of high technology. Such a course, or courses, could be a spin-off from regular academic courses developed in the College of Industrial Management at Georgia Tech. In addition, the possibility exists that client firms of the ATDS could serve as live "case studies" for such courses in the I.M. College. Going one step further, some of the client firms could be well served by student teams serving as management consultants.

The Basic Management Short Courses

In order to assist the managers of fledgling firms develop some capability for the management of their company, special short courses in small business management could be provided dealing with the basics. Because the entrepreneur in a new high technology venture is likely to be an engineer or scientist, there usually is considerable need for some education in the basics of managing a business.

A "Model" Firm

Consideration might be given to utilizing the "incubator" setting for establishing and running a "model firm". The entire activity would be run by graduate students of Georgia Tech, mostly from the College of Industrial Management. There would be a formal tie-in to the academic programs of the College and would most likely be a project activity associated with a course in entrepreneurship. All of the planning and management of the startup process would be conducted by the students, including the securing of venture capital.

Funding Requirements and Options

Georgia Tech is seeking initial funding of $260,000 from the state (for FY81) for the operation of the Advanced Technology Development Service program. Of this total, $210,000 is required for the five program elements and $50,000 is needed for overall administration. In addition, $2,000,000 is sought for one-time expense as the state's share for building an ATDS facility. It is anticipated that $3 million will be available from EDA to match the state's share. There may be a number of ways to fund this proposal. Two alternatives are the following:

OPTION 1: Fund the program ($260,000 FY 81; $500,000 amounts for the next 3-5 fiscal years) from general state appropriations. Georgia Tech would then have to utilize already crowded existing facilities.

OPTION 2: (a) Appropriate $260,000 for programs in FY 81; fund second year program at $500,000; subsequent years' programs would be funded with building revenues. See (b).

(b) Appropriate $2,000,000 through the supplemental budget to match federal funds for the ATDS facility.

Georgia Tech will establish an advisory board of private business leaders to be responsible for making the difficult decisions regarding which small businesses should and can be served. The advice of the Governor is sought regarding whether separate legislative authority for the ATDS should be obtained from the General Assembly.

Management Plan

The Advanced Technology Development Service is designed to report administratively to the Office of the Vice President for Research at Georgia Tech. This will ensure that the program receives attention at the highest operating level and has contact with all R&D projects at Georgia Tech. The program will be managed by a senior staff member who will be provided with support services from all elements of the Institute. Each major program element will be managed by an experienced coordinator who will be responsible for coordination with appropriate state agencies and for performance of his respective unit.

In order to ensure coordination between the ATDS and appropriate state agency and private sector representatives it is proposed that an advisory committee be established with appointments to be made by the Governor. The function of this committee would be to provide general guidance to the ATDS program in the form of goals and objectives and to act as an interface with the local private sector financial and business community.

An organization chart for the ATDS is shown in Figure 1.

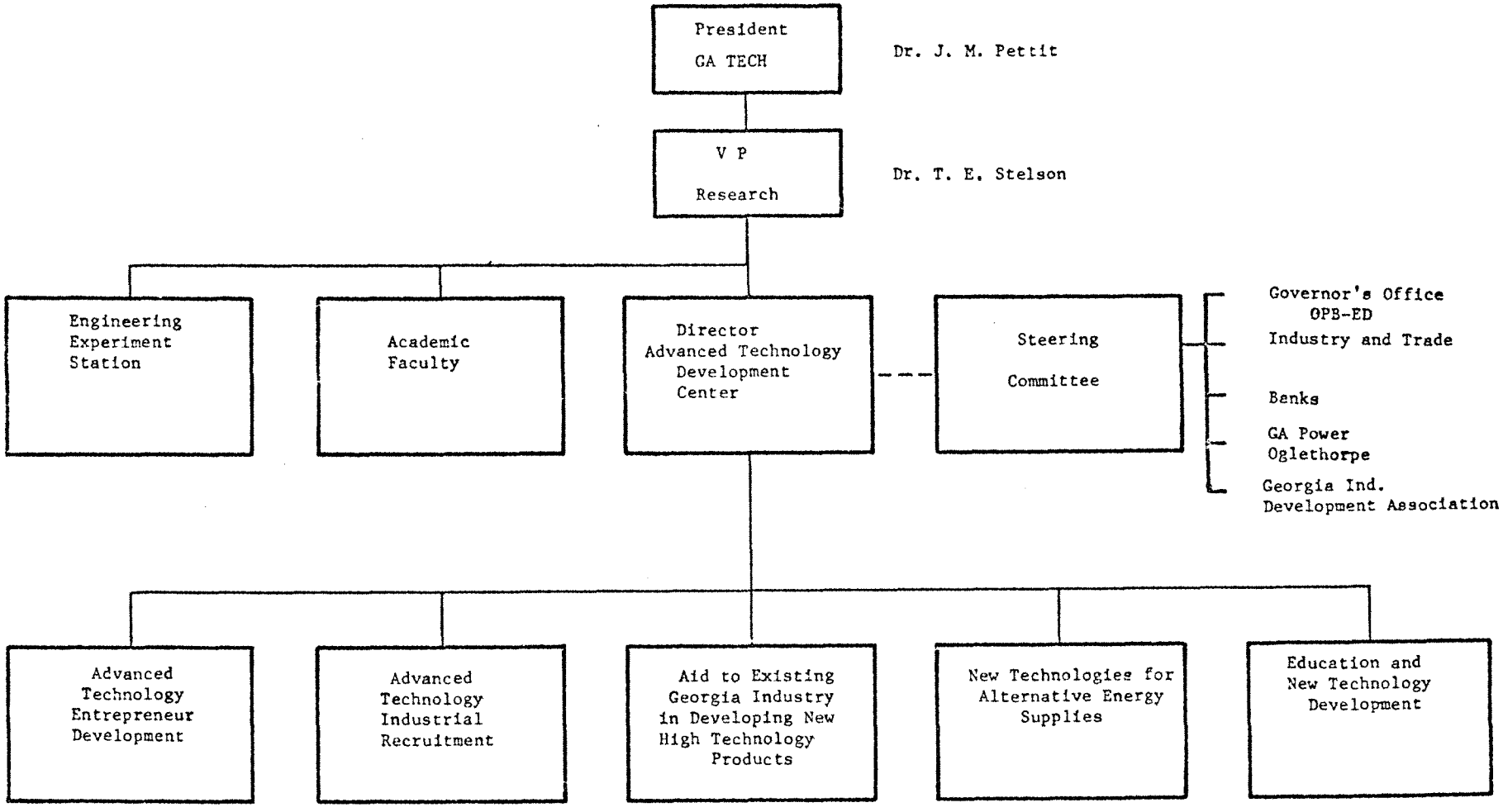

Figure 1. Advanced Technology Development
Service Organization Chart

H. ADDITIONAL INTERVIEWS

One of the elements of the proposed ATDS has the purpose of promoting the development of an advanced technology entrepreneur community. In addressing this element, Mr. Ken Willis, who has participated in the design or establishment of a number of organizations involved in the evaluation and commercialization of new products, was invited to Atlanta to discuss his experience in these matters. An important aspect of the entrepreneur development element is the establishment of a good working relationship between the venture capital community and the entrepreneur. A meeting was held with Brian Haslett of Venture Founders Corporation who is presently working to develop a pool of venture capital in the Atlanta area. The meetings emphasized two major points: the necessity of available seed money for financing new product development and the importance of sound evaluation of venture investment opportunities. The results of the two meetings are included in Appendix III.

I. GEORGIA TECH RELATED ADVANCED TECHNOLOGY COMPANIES

In an effort to better predict and plan for Georgia Tech's role in the future growth of an advanced technology community in Georgia, an examination was made of the status of such a community presently existing. Advanced technology companies, whose origins could be traced through their founders to Georgia Tech, were included in the study. Fifteen companies were examined. Thirteen of those provided annual sales figures and data on the number of people employed annually from the year of company formation. Figure 2 presents this information in graphical form and reveals an exponential growth of sales dollars and employees. It should be noted, however, that the data are dominated by one firm which is currently about five times larger in terms of sales and about six times larger in terms of employees than the second largest company.

Figure 3 indicates the years in which the companies were founded and shows that the period extending from 1959 through 1975 saw a steady number of companies

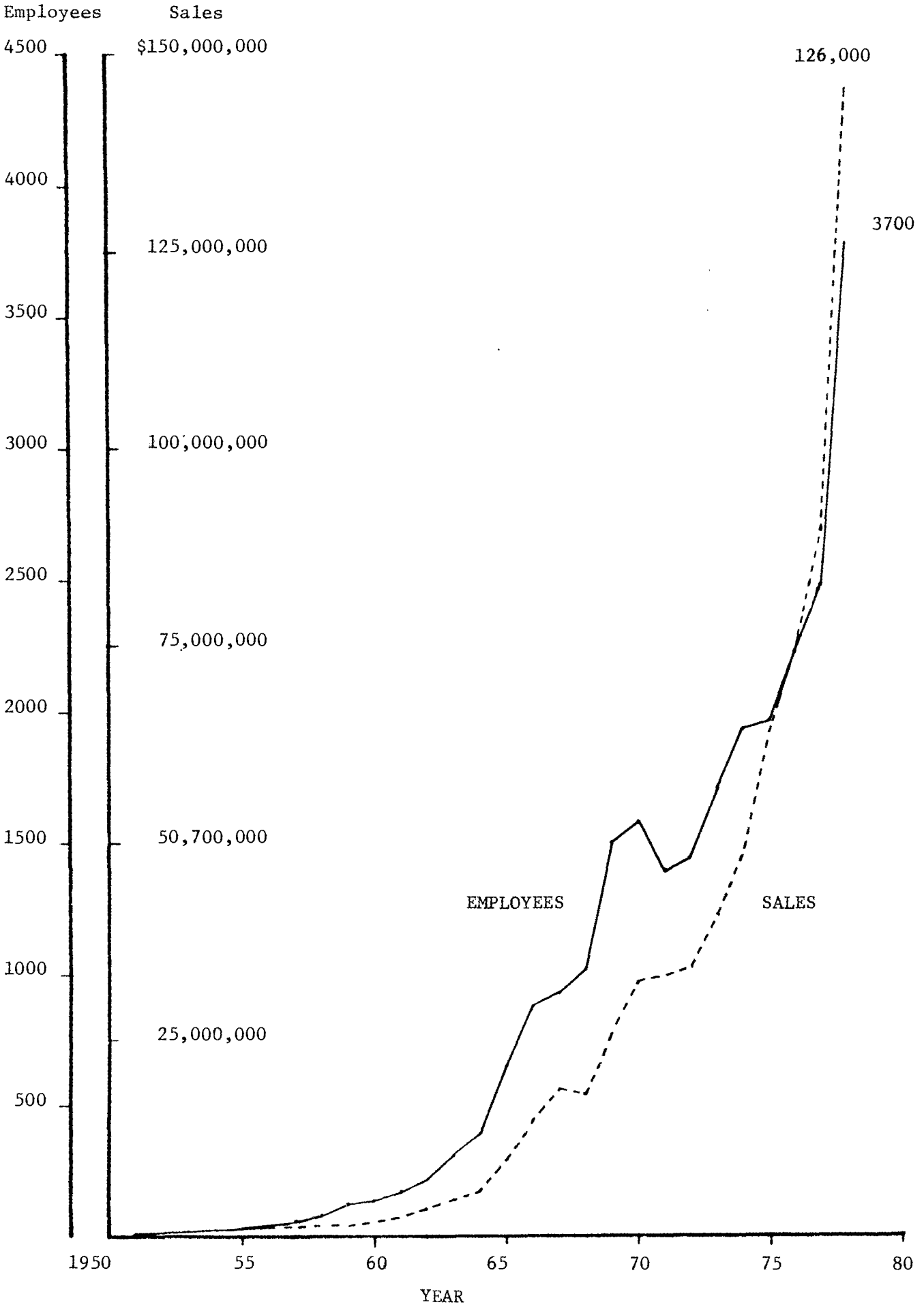

FIGURE 2. Growth of Georgia Tech Related Advanced Technology Companies

forming, averaging one company every 1.3 years. There has been a sharp decline, however, since 1975 with only one new company emerging, that occurring in 1979. It could be speculated, then, that, in the absence of any outside stimulus, the number of companies forming would continue at a rate equal to or less than 1 company per 1.3 years.

To examine the possibilities of high technology growth provided outside stimulation in an effort to effect this growth, a study was conducted and the results are included in the following section.

YEAR	# FIRMS STARTED	CUMULATIVE
1951	1	1
52		1
53		1
54		1
55		1
56		1
57		1
58		1
59	1	2
1960		2
61		2
62	1	3
63	2	5
64		5
65	1	6
66	1	7
67		7
68	2	9
69		9
1970	1	10
71		10
72		10
73	1	11
74	2	13
75	1	14
76		14
77		14
78		14
79	1	15

Figure 3. The Formation of Georgia Tech Related Advanced Technology Companies by Year

J. ECONOMIC IMPACT OF THE ATDS

Of prime concern in the assessment of possible effects of the Advanced Technology Development Service is the measurement of new jobs to be created through the operations of advanced technology firms. Given an estimate of the potential growth in employment due to the ATDS, the overall impact on the economics of the area can be quantified. In order to do this, a working definition of "high technology" was established in the form of SIC codes.[5] This definition was then subdivided into the following four categories so as to facilitate the comparison of developments in different sectors of technology and in different geographical regions of interest:

1) High technology chemical manufacturing.[6]
2) High technology electronics manufacturing.[7]
3) High technology aerospace manufacturing.[8]
4) High technology laboratories.[9]

Employment data for these categories were collected for the years 1959, 1962, 1968, and 1976 from County Business Patterns.[10] Historical employment figures in high technology industries were used as a basis to evaluate the validity of assumptions to be made concerning future employment growth patterns. Data for metro Atlanta and the State of Georgia were compared to data for the U.S. and Santa Clara County, California (Palo Alto area). Santa Clara County was chosen as a focal point for two principal reasons. The development of high technology electronics took place in great part in Santa Clara County which has since become one of the world's most important centers for the research and manufacture of electronic apparatus. Also, the situation regarding this development is highly attributable to the presence of Stanford University. Much of the stimulus for the initiation of the present electronic industry in the area came from support afforded by various factions of the University.

The comparison, therefore, is relevant in light of the fact that Georgia has a university system strong in the various fields of science, engineering, and technology.

In surveying the four high technology categories, it was decided that group #2 and #4 were most relevant to the capacities of Georgia. Given the 1980 estimate of high technology employment in Georgia of 3,562 and assuming the average growth rate that occurred in Santa Clara County from 1959 through 1976, it is speculated that high technology employment in Georgia would grow to approximately 24,000 by the year 2000. Of this total, about 18,000 high technology jobs are directly attributable to the presence of the ATDS, and constitute jobs which historically demand higher than average salaries. In keeping with this trend, it has been calculated that the direct impact of the ATDS would approximate $947 million in wages and salaries of newly created high technology jobs by the year 2000. The creation of direct high technology jobs by the ATDS has a multiplier effect in that it, in turn, is responsible for the creation of indirect jobs. Three scenarios of indirect impact have been presented in Appendix IV as estimated by the application of three possible multipliers. These calculations indicate that the impact of the ATDS could potentially total $1.6 billion in indirect wages and salaries by the year 2000.

K. IMPLEMENTATION EFFORTS

During the second part of the SSET study effort, attention was directed to continuing strong liason between members of the research team, staff of the Governor's office, and members of the private sector to ensure timely implementation of the ATDS initiative. The ATDS, as finally constituted, required financial commitments from the state government and the private sectors for both program activities and physical space for the ATDS. Additionally, commit-

ments from the University System and Georgia Tech were required since the Executive had elected to have the ATDS function managed by Georgia Tech.

Decisions to proceed and concomitant financial commitments for new program initiatives are the responsibility of the Executive in the State of Georgia. These are formalized by inclusion of new proposals into the proposed state budget document for the following fiscal year which the Governor presents to the legislature for consideration and approval. Executive commitment is necessary but not sufficient since the legislature must approve all budget requests. The situation concerning the ATDS is further extenuated since the Governor's decision was to make the ATDS a part of the University System program. This decision required approval in principle for the program by the Board of Regents of the University System and inclusion of funding requests from the Board to the Governor's office through the zero base budget process.

During the fourth quarter of 1978 preliminary approval of the ATDS concept was granted by Governor Busbee. Subsequently, Dr. Thomas Stelson, Vice President for Research at Georgia Tech and Dr. Joseph Pettit, President of Georgia Tech approved a zero base budget element for the ATDS within the Georgia Tech budget proposal to the Board of Regents staff. Formal presentations by Drs. Pettit and Stelson were made to the Board of Regents and approval was granted for requests for both programmatic activities and capital funds to the Governor. These were in the form of $185,000 of state funds for Fiscal Year 1981 program activities, an initial increment of $500,000 in the Supplemental FY-79 budget for land acquisition and preliminary incubator building design, and a first increment of $1.67 million for FY-81 capital funds for incubator building construction. Within these requests were funds for a staff of nine professionals (with salaries to be supplemented from other sources)

and for a building of approximately 90,000 square feet located on approximately three acres of land included within the present boundaries of the Georgia Tech campus. The Governor's budgetary proposal was presented to the legislature for these requested amounts. In addition to direct actions within the state government the Governor directed his staff to initiate actions with appropriate federal agencies to encourage financial support of the ATDS beyond that budgeted by the state. Also, the Governor personally contacted the President's Science Advisor, Dr. Frank Press to brief him of the progress of the SSET program. These actions are anticipated to stimulate negotiations between the Governor's office and federal mission agencies charged with encouraging innovation and economic development.

As stated previously the ATDS will assist in creating an expanded base of scientists, engineers, etc. through private sector initiators. Key to success of the ATDS will be private sector support. A vehicle through which initial financial support can be obtained is the Georgia Tech Research Institute (GTRI). This private, non-profit corporation works closely with the business community (several board members are prominent industrialists) and the Georgia Tech community. GTRI was recognized early in the study by the Committee of Twenty as a logical support entity and the Board of GTRI has been kept informed of progress on the SSET program and on the ATDS concept.

In addition to financial support the GTRI is anticipated to play an integral part in the on-going operation of the ATDS. The organization has considerable experience in negotiating contractual agreements between Georgia Tech and sponsoring agencies. It is anticipated that this expertise will be valuable in assisting entrepreneurs through the difficult legal steps leading to stable business operations. Also, because GTRI and Georgia Tech have an established memorandum of understanding concerning legal aspects of research operations,

property management of space, and other administrative matters GTRI may be a useful adjunct to ATDS operations, especially where private organizations have greater leeway than is afforded Georgia Tech through the state government system.

Continued support by the Governor is anticipated to lead to approval of the ATDS budget element by the legislature. Upon approval by that body active implementation of the ATDS program will begin. The first step in the process will be initiation of land acquisition and preliminary building design. An Architect-Engineer will be retained, conceptual designs will be formulated, and detailed designs will be undertaken. Simultaneously recruitment of key ATDS personnel will be initiated. Program activities will be scheduled to begin in the third quarter of 1980.

L. CONCLUSION

The incorporation of the ATDS component into the existing central management system will be an asset to the SSET mechanism in following the criteria set to achieve its primary goal of improving the working relationships between the Chief Executive and existing or potential scientific and technological resources. The factions of ATDS will enjoy the informal accessability to the Governor and SET resources through direct linkages while at the same time establishing the State of Georgia among the leaders of science and technology development through extended research capability and foresight in this dynamic environment. The importance of the objectives specifically identified in the proposal for the ATDS, in addition to the informal communication flow, will enhance the incorporation of the SET mechanism into the Governor's decision making process. The multilateral direct communication will ensure appropriate and immediate responses to changes in State needs and national trends and opportunities. Therefore, the establishment of the ATDS is seen as a beneficial component addition to the SSET program which complies with

the original and primary objective of the program while leading the State of Georgia into the forefront of growth and development.

FOOTNOTES

1. Memorandum of Stu Eizenstat to the Secretary of the Treasury, et. al., entitled "Issue Definition Memorandum: Federal Policy on Industrial Innovation", The White House, Washington, D.C., May 9, 1979, p.1.

2. William C. Norris, et. al., "Recommendations for Creating Jobs Through the Success of Small, Innovative Businesses", A Report to the Assistant Secretary of Commerce for Science and Technology, December, 1978, p. 1e.

3. "Technical Innovation: Its Evironment and Management", U.S. Department of Commerce, Washington, D.C., 1967.

4. Robert M. Colton, "Technological Innovation Through Entrepreneurship", Engineering Education, November, 1978, p. 193.

5. High technology industries are defined as those listed under SIC: 2819, Industrial inorganic chemicals n.e.c.; 2821, Plastics materials, synthetic resins, and nonvulcanizable elastomers; 2822, Synthetic rubber (vulcanizable elastomers); 2824, Synthetic organic fibers, except cellulosic; 2831, Biological products; 2833, Medicinal chemicals and botanical products; 3573, Electronic computing equipment; 3622, Industrial controls; 3662, Radio and television transmitting, signaling and detection equipment and apparatus 3673, Transmitting, industrial and special purpose electron tubes; 3674, Semiconductors and related devices; 3679, Electronic components n.e.c.; 3693, Radiographic x-ray, fluoroscopic x-ray, therapeutic x-ray, and other x-ray apparatus and tubes, electromedical and electrotherapeutic apparatus; 3721, Aircraft; 3761, Guided missiles and space vehicles; 3823, Industrial instruments for measurement, display, and control of process variables and related products; 7391, Research and development laboratories; 7397, Commercial testing labs.

6. High technology group #1 consists of SIC: 2819, 2821, 2824, 2831, 2833.

7. High technology group #2 consists of SIC: 3573, 3622, 3662, 3673, 3674, 3679, 3693, 3823.

8. High technology group #3 consists of SIC: 3721, 3761.

9. High technology group #4 consists of SIC: 7391, 7397.

10. U.S. Bureau of the Census, County Business Patterns, 1959, 1962, 1968 and 1976, U.S. Government Printing Office, Washington, D.C.

Appendix I

Trip Report

TRIP REPORT
San Francisco, Los Angeles
June 18-21, 1979

The densest concentration of innovative advanced technology industry is found in a triangular wedge of land twenty-five miles long and ten miles wide along the southwestern shore of the San Francisco Bay. In 1974, some 800 pioneering technology companies were located here, most of which were founded in the area. A visit to this area and to the large urban center of Los Angeles afforded the opportunity to gain firsthand input on Georgia Tech's proposed Advanced Technology Development Center (ATDC). This input came from three sources which are believed to be critical in the establishment of the ATDC and are the following:

1) Technical University personnel
2) Advanced technology entrepreneurs
3) Venture capitalists

A summary of the information which was gained as a result of this trip follows. Included after this is a detailed write-up of each interview.

Summary

Four factors have been identified which were critical in the growth of advanced technology industry around Stanford and are the following:

1) Research work at Stanford - Palo Alto is considered the birthplace of electronics and research at Stanford included pioneering work in nuclear magnetic resonance, high power Klystron development, and high voltage x-ray generation with linear accelerators.
2) Working relationship between university personnel and the private sector - A strong communication channel existed between the research personnel at Stanford and many Stanford graduates, and was the vehicle needed to bring about the commercialization of university research.

3) Lack of jobs for technically educated community - There was not a great demand for engineers in the area around Stanford in the thirties. Stanford graduates, therefore, were forced to leave the area or start their own companies.

4) Frederick Terman's determination and leadership - Dr. Terman, former provost of Stanford, sought to prevent the loss of so many Stanford graduates to other parts of the country. He did this by encouraging the start of new businesses in the area through programs such as the establishment of the Stanford Industrial Park.

Today, the high cost of housing and the many restrictions set by the Stanford Industrial Park are factors which are causing many companies to look elsewhere for new plant locations. The Park places strict building limitations on the tenants. Structures are limited to two stories and the maximum land coverage ratio is very low. Housing costs are extremely high in the Palo Alto area and no effort has been made to provide reasonably-priced housing. This forces many employees to commute long distances and makes employee recruiting very difficult.

Hewlett-Packard and Varian Associates both conduct research at their manufacturing plants which generally requires technically trained personnel with masters and/or doctorate degrees. Therefore, access to a technological university for advanced degree work opportunities is important in selecting plant sites. Georgia would be an ideal location for a new H-P or Varian plant because the video-based instructional system at Tech makes it possible for people all over the state to earn a graduate engineering degree from Tech. This is an advantage to companies in recruiting employees. Hughes Aircraft Corporation, as a matter of fact, utilizes this type of set-up with U.S.C. and advertises the fact to aid in recruiting students. The Honors Cooperative Program at Stanford is another recruiting aid. It allows a company to guarantee acceptance in graduate school at Stanford to a prospective employee who has met certain qualifications.

H-P would like to work more closely with Tech especially for the purpose of hiring Georgia Tech graduates. H-P would consider locating a research group in the ATDC at Tech in order to strengthen the relationship between H-P and Tech.

H-P recently selected the Research Triangle over Atlanta as the location for a new plant because of the visible supportive relationship between the universities and industry. This supportive relationship between the RTI universities and industry was emphasized by RTI representatives on various visits which they made to H-P to discuss the possible location of an H-P plant in North Carolina.

This location of an H-P plant in an already-developing high technology industry center leads to a "critical mass" theory which predicts exponential growth for the ATDC. It is expected that the growth rate will be slow initially until the critical mass of industry is reached. At that point other industry will be attracted by the existing industry due partly to the highly visible relationship between the university and industry. In addition to this, supply industries will be formed or will move to the area and spin-off companies will emerge from the existing companies.

It is expected that such a growth in high technology industry with its need for graduate study opportunities will result in an increase in the graduate programs at Tech. This was the case at Stanford. The engineering graduate students out-number the undergraduate students today, although this was not the case in previous years.

Several programs which have been discussed as part of the ATDC have precedents at other universities. The Industrial Engineering Department at Stanford has a program to offer management aid to small technology businesses. The University of Southern California offers courses designed to educate potential entrepreneurs. This is done by offering a program in Entrepreneur and Venture Management as part of a Masters of Business Administration degree. U.S.C. and U.C.L.A. both have Industrial Associate Programs which provide many benefits to

industry members such as consulting privileges with faculty, publications of university research programs, laboratory equipment and facilities usage, library privileges, and graduate recruitment assistance. Membership in the Industrial Associate Program is obtained by donating funds to the School of Engineering. This provides the School access to funds without going through the long budgeting process.

University personnel, successful entrepreneurs, and venture capitalists all agreed that a critical factor in the ATDC is the availability of capital. Reid Anderson, founder of Verbatim Corporation as well as several other companies, identified space, money, and legal services as essential for entrepreneurs. Robert White in the Electrical Engineering Department at Stanford discussed the advisory role that faculty members play as technical consultants for the venture capital community. Ed Ginzton, Chairman of the Board for Varian, Associates, recommended liberal patent and consulting policies for faculty members in order to stimulate entrepreneur activities.

Members of the venture capital community which were interviewed recommended the involvement of local people in the venture capital effort. Venture capital firms are not geographically restricted, but because they are often involved in the management of the companies in which they invest, they prefer to stay close to home. It is important, therefore, to develop a local venture capital community. In addition to this, the banking community should be educated so that it could give direction to entrepreneurs who come to it seeking capital.

Venture capital firms have different investment policies. One which was interviewed set a minimum investment amount at $100,000 while another preferred not to invest less than $300,000. Reid Anderson, however, discussed Exxon Development Corporation which will invest a small amount of money for prototype

development. After evaluation of the prototype, a large amount of money may be invested. California and Wisconsin were mentioned as two states which use money through state-backed tax-exempt bonds to aid new and young businesses.

Hewlett-Packard Company

Hewlett-Packard was founded in 1937 by two Stanford graduates at the encouragement of Frank Terman. Today it is one of the world's largest producers of electronic measuring devices and equipment reporting sales in 1977 of $1.3 billion. Headquartered in the Stanford Industrial Park adjacent to the Stanford campus, H-P still benefits from this university tie.

Dan Lansdon, Administrative Manager. The interview with Mr. Lansdon provided some insight into the structure of the company and the policy for R&D. H-P is structured so that each plant is a division with basically one product line. Each plant has its own R&D group if necessary. New divisions tend to rely on corporate R&D more heavily than do older divisions. Corporate R&D is provided with about 1½% of the sales dollar while a total of about 10% is spent on R&D company-wide. Corporate R&D generally performs long-term or high-risk research as well as that which is new or general to the whole company.

Most of H-P's R&D work is performed in-house with little cooperative research done with university personnel. University consultants, however, are sometimes utilized and H-P occasionally funds research at universities on a fellowship basis.

H-P predominately hires electrical engineers and, for the R&D operations in the plants, graduates with master's degrees are preferred. Students with only a B.S. degree may be hired, but are urged to further their education. Proximity to a major technical university is important, therefore, for advanced study possibilities. H-P participates in the Honors Cooperative Program at Stanford which allows the top graduate students the opportunity to gain part-time work experience. It is possible sometimes for such students to work on H-P R&D programs for publication.

Mr. Lansdon indicated that H-P would like to work more closely with Georgia Tech, especially for the purpose of hiring top-notch graduates. The idea of locating an H-P research group near the Tech campus was presented and has possibilities because H-P is still very flexible for a company of its size. H-P generally cannot afford to do basic research, but such a group could have the potential for working on broad fundamental problems. Assurance of security is of utmost importance, however, as proprietary rights must be retained.

John Moll, Director, Integrated Circuit Laboratory. Dr. Moll discussed H-P's relationship with universities. Corporate policy dictates that university affiliations must be directly related to H-P's interests. He mentioned that Illinois and Minnesota are two universities which have industrial affiliates programs. He would like to see H-P involved in this type program, but he has not had success in selling the idea to the decision-makers. This type of relationship could possibly help to improve the programs for student development. Dr. Moll does not like to hire Ph.D's who are highly trained in one area. This tends to narrow their sight.

H-P does not engage in much research outside of the company due to the need to retain proprietary rights. It could be advantageous to H-P to be able to lease land near Georgia Tech, however, in the same manner in which it leased land in the Research Triangle. It is expected that the Scientific Instruments Division will move there. The Dean of one of the Research Triangle universities visted Dr. Moll when H-P was considering the Research Triangle as a new location.

Dr. Moll believes that the up and coming field for research and development will be in large-scale integrated circuit design which will require a new engineering science field. The universities should aim to prepare students for this work, but any attempt by the universities to keep up with industrial capability is futile due to the prohibitive cost of entering the field.

John Brown, New Site Selection. Mr. Brown stated that the main tie to Stanford lies in the opportunities for graduate studies. H-P maintains a large corporate R&D operation but also has R&D groups in the divisions. Proximity to a technological university, therefore, is important in selecting a new plant site, making Atlanta the only desirable location in Georgia. Academically speaking, Georgia Tech is as good as about anyone and has good graduate opportunities. Mr. Brown believes that the ATDC could be attractive to H-P personnel by offering them the opportunity to conduct basic research.

Mr. Brown revealed that H-P had recently decided to locate a new plant in the Research Triangle as opposed to Atlanta. Research Triangle was chosen due to the visible supportive relationship between the universities and industry. This direct co-operative relationship with industry was not as apparent at Georgia Tech. H-P benefits from ties to technological universities and possibly even medical schools.

The Governor's role can be very helpful in attracting a company such as H-P by offering tax incentives and a non-prohibitive environment. H-P prefers to locate in a state whose government wants industry. California laws are highly restrictive, making expansion in the state very unattractive.

Verbatim Corporation

Verbatim Corporation recently celebrated its tenth anniversary in the magnetic data storage media industry. Verbatim manufactures diskettes, cassettes, data cartridges, and magnetic cards. This year marked the fifth anniversary of the establishment of the European office in Geneva, Switzerland and a new 40,000 square foot plant was opened in Limerick, Ireland on April 30th. The company employs over 750 people with sales on the order of $20 million.

Reid Anderson, Founder-Chairman. Mr. Anderson is an experienced entrepreneur, having founded several companies in his career. He stated that space, money and legal services are important to entrepreneurs. He gave us references

to several venture capital firms to contact, which are listed below, and said that founders of companies often have only 5-10% interest in their companies. Some venture capital firms, such as Exxon Development Corporation, will invest a small amount of the seed money for prototype development. After an evaluation is made of the prototype, it is possible that more money will be invested.

Venture Capital Firms:

Institutional Venture Associates; Reid Dennis, President of the Venture Capital Association (415) 854-0132.

Jack Melcore (415) 941-6766

Sutter Hill; Bill Draper, Dave Anderson (Palo Alto)

Exxon Development Corporation; Ben Sikes (N.Y.C.)

Verbatim is looking for a location for a new manufacturing plant outside of California. Maxell and TDK are two competitors who are each locating new plants in Georgia. Maxell's will be in LaGrange. Production managers and untrained production personnel are necessary factors in the new location.

Stanford University

Robert White, Electrical Engineering. Economic pressure causes faculty members to seek outside consulting opportunities or business ventures. A major problem for entrepreneurs has always been the acquisition of capital funds. Venture capitalists often play an important role, therefore. Stanford faculty members have worked with venture capitalist firms in offering technical advice in return for small royalties. Dr. Pettit was involved with this when he was at Stanford.

The I.E. School at Stanford has a program designed to aid in the management of small technical businesses. Henry Riggs is the director of that school.

Farrell MeGhie, Office of the Dean of Engineering: Ken Down, Head, Honors Cooperative Program: Frank Terman's technical expertise was a major factor in the development of the Stanford Industrial Park. R&D activities require people with advanced degrees, therefore, Stanford was also an important attraction to advanced technology companies. The evolution of the area has, in turn, had an effect on the graduate student population. Graduate students now outnumber the undergraduates.

The Honors Cooperative Program (HCP) was set up in 1953 to enable qualified engineers and scientists from nearby companies to pursue graduate degrees at Stanford on a part-time basis while maintaining full-time professional employment. The establishment of the Stanford Instructional Television Network has brought the classroom to the students at their place of employment. This aids companies in recruiting because they can hire graduates who meet certain requirements and guarantee their acceptance to graduate school at Stanford. The participating companies are required to sign a five-year contract to enroll students because the professors who teach the courses are hired on a five-year basis. They must also match the tuition in order to better cover costs. A student who does not meet the requirements for graduate school may enroll on a non-registered student basis. If he does well, he can then be accepted based on his performace.

N. C. State is aggressively pursuing high technology businesses and is establishing a television program to aid in this effort. Hewlett-Packard has located plants where there is no major technological university because they can receive the graduate programs recorded on tape. This is presently being done by H-P in France and Germany.

Varian Associates

Varian Associates manufactures microwave products which play an indispensble role in systems for communication, air navigation, space exploration, and

national defense. The product line is varied and includes microwave tubes, solid state devices, digital computers, data systems, analytical instruments, and linear accelerators. Founded 31 years ago in 1948, the company reported sales in 1977 of $376 million. Varian Associates was the first tenant of the Stanford Industrial Park and today occupies 80 acres there. The company intentionally settled near Stanford in order to enjoy the benefits of interchange with the various scientific programs in progress at the University. It proved to be a rich period of invention at Stanford. Pioneering work in nuclear magnetic resonance was being completed and Varian obtained the patent rights. Also at that time, William Hanson and Ed Ginzton, new Chairman of the Board, were building the first linear accelerators for high energy physics research at Stanford.

Ed Ginzton, Chairman of the Board. Mr. Ginzton has been a director of Varian Associates since its establishment. He later joined the faculty in the Physics Department at Stanford to develop the Microwave Laboratory and also headed the group which proposed the construction of the two-mile-long linear accelerator. It is interesting that his work at Stanford played a major role in the success of Varian Associates, yet, today, as Chairman of the Board, he certainly does not view the relationship with Stanford through rose-colored glasses. Today industry faces serious constraints in the Palo Alto area which are forcing many companies to look elsewhere for expansion. Mr. Ginzton identified the following three constraints:

1) The Stanford Industrial Park places strict building limitations on the tenants. Structures are limited to a two-story maximum and the land coverage ratio is set at a very low percentage.
2) Industry in the Palo Alto area is having a difficult time recruiting employees due to the extremely high housing costs. No effort has been made to provide reasonably-priced housing and many employees are forced to commute long distances.

3) There was apparently no regard for the effect of industry on the community. Today, the industry in Palo Alto is very unpopular with the people of the community because it has encroached on their beautiful area making it noisy, crowded and dirty.

Mr. Ginzton cited the lack of jobs for engineers as one reason for the growth of industry in the area. In the late thirties when Stanford was graduating such men as Ginzton, Hewlett, and Packard, there was little demand for engineers in the area. Graduates were forced to seek employment elsewhere or start their own companies.

Varian considers the availability of workers important in locating a manufacturing plant. This includes all types of people such as accountants, lawyers, production workers, and both B.S. degree engineers and M.S. degree engineers. Varian encourages its satellite plants to do their own R&D work, but 60-70% of the R&D activities are performed at the corporate location. Even with no R&D work, however, high technology businesses cannot manufacture without engineers.

In response to the ATDC concept, Mr. Ginzton made the following suggestions to insure its success:

- Georgia Tech should continue to provide a supply of well-trained people who want to stay in the area.
- Georgia Tech should continue R&D activities.
- Georgia Tech should have a liberal policy for consulting by faculty members as this can be an extremely important ingredient in high technology companies.
- Georgia Tech should have a patent policy for faculty to encourage the commercialization of university research by faculty members.

- The provision of physical space for entrepreneurs is not a major concern; however, the availability of venture capital is extremely important.

Looking to the future, Mr. Ginzton cited energy, health care and medicine as fields which have limitless possibilities for advanced technology research and development.

Institutional Venture Associates (IVA), Menlo Park, California

Institutional Venture Associates is a privately held venture capital partnership organized in 1974 to make equity oriented investments in businesses which offer favorable opportunity for significant growth in size and value. The major focus is the financing of privately held, developing companies. The general partners are men with technical degrees which are coupled with business degrees or experience.

Burgess Jamieson, General Partner. Mr. Jamieson stated that although IVA sells investment opportunities in U.S. based businesses operating without geographical restriction in the U.S., investments of a seed capital nature are usually limited to the West Coast. The reason for this is that distance diminishes the capability to support businesses which are in an early stage of growth. The company seeks to make major financial and support commitments to a relatively limited number of companies rather than smaller investments in a larger number. The preferred investment size is $500,000 to $1,000,000 and $300,000 is the minimum level considered. Maximum investment is limited to $2,000,000. The company prefers to invest with other investors who have similar motivations, investment objectives, and financial resources. In furtherance of its role as an active investor, a general partner often serves as a director of a portfolio company.

The evaluation of investment opportunities involves the following major areas of interest:

-- Review of market opportunity and competitive environment

-- Products and product strategy

-- Management structure, individual credentials, and capabilities

-- Financial projections for a 3- to 5-year period

-- Current financial statements

-- Description of proposed financing--size, suggested terms, and application of proceeds.

In response to the geographical restriction on investments of a seed capital nature, Mr. Jamieson stated that local people or corporations with available investment resources must be involved in the ATDC effort.

Brentwood Associates, Los Angeles, California

Brentwood Associates is a private investment partnership which invests in the equity securities of companies that, though generally higher in risk, offer unusual potential for capital appreciation relative to more conventional investment alternatives. Investments are made in new companies as well as in mature companies, but almost all investments have been involved in technology development. Brentwood seeks to be an active partner in the companies in which it invests usually through participation on a company's board of directors. Brentwood seeks to support management generally at a policy level.

Investments are concentrated in a relatively few number of companies and generally range from $250,000 to $750,000 with no maximum specified. A position as low as $100,000 will be considered, however. Almost all of the early stage investments are made by Brentwood Associates, Inc. (BAI) which is a Small Business Investment Company (SBIC) wholly-owned by Brentwood Associates.

BAI was the first SBIC instituted by a major partnership venture capital organization and is employed whenever a potential investment qualifies under SBA regulations.

Lucien Ruby. Mr. Ruby stated that Brentwood Associates has invested in an Atlanta-based company and is presently considering an investment in East Tennessee. They would prefer to invest closer to home because it is cheaper with respect to time. This is a result of the management assistance which is provided along with the financial assistance. They consider this critical in gaining the desired rates of return on their investments. The venture capital business is highly competitive today, so that firms are more willing to travel longer distances for a promising investment.

Mr. Ruby identified three essential factors which, when combined, will attract the venture capital. These are listed below along with suggestions for providing these:

1) Product or service - This of course is the starting point for a business. New products or services often stem from university research and Georgia Tech could facilitate this by disseminating information on areas of research to potential entrepreneurs.
2) People - Any business is dependent on people and Georgia Tech has been in the business for many years of producing technically trained people. To attract such people from other areas of the country, the provision of relocation services could be advantageous.
3) Environment - An environment conducive to industry is important. This can be provided by a favorable tax structure and a limitation on restrictions.

Mr. Ruby made the following suggestions in relation to the ATDC:

- Be careful that you are not supporting research as opposed to development.
- The provision of low-cost space can be an important aspect, but don't make it too easy for the tenants or you may end up with tinkerers who will never move out.
- Faculty advisors can be of value in making investment decisions. Venture capital firms often pay consultants when evaluating investment opportunities of an advanced technology nature. Two example investment firms which utilize faculty advisors are Mayfield in San Francisco which maintains a relationship with Stanford and the Charles River partnership which works with MIT faculty.
- The banking community should be educated about the venture capital community. Bankers would then be able to give direction to entrepreneurs who come to them seeking venture capital. Brentwood Associates would be willing to work with Georgia Tech in doing this.
- Entrepreneurship courses are good because they aid the communication process by teaching entrepreneurs the language of venture capitalists. The Institute of New Enterprise Development in Belmont, Mass. holds 4-day seminars for training entrepreneurs. Lynn Smallen is a person to contact there. The Canadian government is a client of this group.
- Assistance programs in packaging a business plan for submission to a venture capitalist could be a great aid to entrepreneurs. Ideas, like all things, must be marketed. Companies do exist which provide this service, but they often do not do a good job.

Fred Warren. Mr. Warren also showed an interest in the ATDC project and expressed an interest in investing in the Atlanta area as they already have one investment here. The firm likes to have a local investor on the scene to monitor

the project, but if this is not available they may be represented by a person from another local company.

Mr. Warren mentioned that at least two states, California and Wisconsin, use money through state-backed tax-exempt bonds to aid new and young businesses. This is also the role of small business investment firms (SBIC). He also mentioned that the California university system is a limited partner in Brentwood Associates.

Mr. Warren will be in Atlanta in July and is willing to discuss this project further at that time. He also recommended Mike Fortique (453-1750) as a potential source of information in Atlanta.

Jack Menushian, Director, Interactive Instructional Television Program (I-ITV), USC

The location of industry in the urban center of Los Angeles is due to forces other than those which created the advanced technology industrial center in Palo Alto. Dr. Menushian cited the following factors which attracted industry to Los Angeles and which are generally existant in all large urban centers:

- Available labor forces
- Diversity of educational opportunities
- Cultural and social attractions for living there

Kathi Collins, Assistant Director, I-ITV, USC. The University of Southern California is an urban university in the heart of Los Angeles. Graduate courses leading to graduate degrees and employee development courses are telecast live to companies within a 30-mile radius. Engineering courses are the main emphasis of the TV program and are used mainly by the aerospace and electronics industries. Banks in downtown LA benefit from the employee development courses. Although USC did not attract industry to LA, it certainly is aiding in further development of the company's employees. Hughes Aircraft Company, the biggest client of I-ITV, is using the TV program in its recruiting ads (see following page).

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Kathy Huber, Administrative Assistant to the Director, Entrepreneur and Venture Management Program, USC

In 1972, the University of Southern California became one of the first universities to establish a full program for potential entrepreneurs. This was in response to the clear and growing need for more trained entrepreneurial talent and was done in the Graduate School of Business Administration by offering a program in Entrepreneur and Venture Management as part of a Master of Business Administration degree.

The program is a sixteen unit program which is team-taught by faculty and outside guests. Eleven units are taught in formal classroom settings and emphasize concepts, theories, and tools. Many visiting entrepreneurs and experts share their experience and knowledge in classes and rap sessions. Case studies are used to help develop the ability to conceptualize and to apply what has been learned. Three units are devoted to the development of each student's own venture proposal. This is done out of class, after which, each proposal is evaluated by an individual committee including members of the Advisory Council, program alumni, and faculty. Two units are used for individually designed consulting or work-for-credit experiences and is designed to help students gain exposure to and experience in areas important for their own development. Much emphasis is placed on practical skills and knowledge and on learning through experience.

Applicants for the program are screened to insure that seriously-minded entrepreneurs are selected as enrollment is limited to about 60 each year. Fall of this year will be the first time that the courses will be offered to non-degree candidates in the undergraduate school.

Over 200 students have graduated from the program and are strongly urged to obtain a depth of experience in the area they wish to enter before starting their own company. Some immediately started companies and have proven successful. An

alumni association allows the graduates to remain in contact with each other and the program. This is facilitated by a regularly-published newsletter which includes business opportunities. Alumni seminars are also held.

A venture capital liaison program is presently being developed. The advisory council, which consists of successful entrepreneurs who have either founded or who head their own company, has been the main link to the venture capital community.

Dr. John Marshall, Director, Industrial Associate Program

The Industrial Associate Program offers technologically-oriented companies special opportunities for interaction and cooperation with the School of Engineering in furthering common goals in engineering education. Industrial Associates allocate $5000 or more annually for unrestricted support of the School's teaching, research, and service programs. This provides access to funds without the long budgeting process, allowing, for example, the funding of short-term research.

Participation in the program establishes a formal channel of communication between the university and industry. From the program a board of councelors is assembled which meets once a year to insure that industry and the university are in contact with one another. One item on the agenda for the meeting is a discussion on the curriculum of the school and any changes which should be made to better prepare students for their careers.

Through membership in the program, Industrial Associates are entitled to the following benefits:

- Privileged access to the faculty and informal consultation. Industrial Associates have privileged access to USC faculty to review recent developments in technical areas in which the company is active or contemplating activity, and for informal consultation on specific problems. Meetings may be either on-campus or at the company's facilities, and

members may take advantage of this benefit by scheduling in-plant group meetings or seminars for their engineering and science staff. Privileged access to the faculty under the Industrial Associate relationship is distinguished from long-term formal consultation which is arranged between companies and individual faculty members.

- Publications by members of the faculty. Copies of technical publications by members of the faculty are available to Industrial Associates. These include detailed reports on research programs in the School, preprints and reprints of technical articles, and presentations at science and engineering meetings and symposia.
- Seminars and research reviews. Industrial Associates are notified of the numerous seminars in science and engineering scheduled on-campus each month, and are invited to suggest subjects directly related to their specific problems or fields of activity. Members are also invited to have representatives attend special seminars and periodic reviews of progress on various research programs in the School of Engineering.
- Use of the school's laboratory equipment and facilities. Companies occassionally require specialized equipment or facilities for conducting tests and investigations. Arrangements may be made through the Industrial Associate Office for members to use such equipment and facilities in the laboratories of the School, at minimal cost, at times when they are not being utilized by students and faculty. Among the facilities available are the low-speed wind tunnel and anechoic chamber in Aerospace Engineering; hypersonic range in Mechanical Engineering; stratified fluid flow and strength of materials laboratories in Civil Engineering; high-pressure compaction, and mechanical and

physical properties test equipment in Chemical and Petroleum Engineering; and numerous specialized laboratories in Electrical Engineering and Materials Science for studies in X-ray diffraction, spectroscopy, light scattering, microelectronics, electron microscopy, magnetic resonance, crystal growth, electron microprobe analysis, high-power lasers, computer image processing, and low-temperature properties of materials.

- Assistance in recruiting graduates. The Industrial Associate Office, in cooperation with the University Career Planning and Placement Center, assists member-companies in recruiting engineering and science graduates, and provides separate interview facilities within the School of Engineering. In addition, designated management personnel in each company are furnished an annual compendium of biographical data on graduate students to assist in selecting for consideration those with qualifications and interests suitable for future positions with the company.
- Library privileges. Industrial Associates are entitled to full privileges at the University's extensive libraries. A Library Courtesy Card is furnished to the company or division technical librarian, or other authorized personnel, and may be used for inter-library transfers or loaned to company employees for use while visiting the campus.
- Announcements of new academic programs and special courses. Designated technical and training personnel in each member-company also receive announcements of new academic programs, intensive short courses for updating practicing engineers, and a variety of continuing education programs.

- Use of university conference facilities. The auditorium and conference facilities in the School of Engineering and at other locations on the campus are available to Industrial Associates for special company meetings and activities.

- Other opportunities for interaction-joint research efforts. The Industrial Associate Office is available to assist member-companies in developing other avenues for interaction with the School. An example is the establishment of cooperative research programs. There has been increasing interest by industry in sponsoring basic research at university laboratories. An educational institution can generally conduct programs in specialized technical areas at substantially lower cost than industry. The School of Engineering offers excellent opportunities for such cooperative efforts. It has the investigative manpower and specialized instrumentation required for research in a broad range of technological areas. Programs may be concerned with the solution of existing engineering problems, product improvement, or the development of new products or processes.

Appendix II

Advanced Technology Development Service Proposal

Proposal

for

Advanced Technology Development Service

Prepared

by

The Georgia Institute of Technology

September, 1979

Georgia Tech
Advanced Technology Development Service

- A proposal by Georgia Tech for state funding of the Advanced Technology Development Service program and supporting facility.
- The purpose of the proposed Advanced Technology Development Service is to stimulate growth of High Technology Industry in the state.

The project is based upon premises:

1. Georgia lags behind other sections of the U.S. in high technology industry and jobs.
2. More jobs are created in the U.S. by newly created firms and expanding small firms than by medium and large firms combined.
3. High technology jobs have a higher wage base and the job base is not as sensitive to downturns in the economy.
4. Applied engineering research produces innovations for new products and new and expanding firms.
5. Georgia Tech's contract engineering research has grown from $10 million to $37 million in less than five years. Because of Georgia Tech's growing research programs, private companies in Georgia are beginning to do more research.
6. The federal emphasis on increased support for technological innovation may provide significant support for high technology product innovations. Georgia could take greater advantage of federal programs if a Georgia program were in place and operating.
7. Georgia Tech's leadership in Alternative Energy Systems Research may provide a basis for new, high technology industrial growth.

This proposal is a result of a joint effort of Georgia Tech and the private sector. The state is being asked to provide funding for the on-campus program.

The private sector groups involved in the project are seeking to develop venture capital sources, a more favorable banking climate for high technology firms, and to marshal the long-standing support of the Georgia Business Community.

Proposed ATDS Elements

- Advanced Technology Entrepreneur Development
  - Assist entrepreneurs in solving unique technology problems
  - Provide incubator space for new, high technology firms
  - Assist in venture fund location
  - Help to create a venture capital community
- Advanced Technology Industrial Recruitment
  - Assist I & T and local industrial development groups in attracting new industry
  - Recruit advanced R&D elements of major firms who may locate in Georgia
- Aid to Existing Georgia Industry

  Assist firms in finding markets

  Identify technical products for expansion
- Alternative Energy Venture Stimulation
  - Develop market information on energy product markets
  - Develop wood and biomass energy products
- Education
  - Hold seminars for R&D managers
  - Provide high technology management training for students

- ATDS Facility
  - Serve as incubator space for entrepreneurs
  - Provide facilities for training managers and entrepreneurs
  - Act as a focus for recruitment of high technology industry
- Facility would be funded by:
  - Private Sector
  - State Government
  - Federal Government

BENEFITS

I. State's Benefits
   A. Economic development promotion
      1. New job creation
      2. Higher paying job creation
      3. Increased industry tax revenues
      4. Standard of living increase
         a. Increased need for products and services
         b. Increased income per capita
   B. Cultural and social advancement
      1. Better educated citizens
      2. Increased interest in fine arts

II. Georgia Tech's Benefits
   A. Academic improvements
      1. Increased national and international recognition
      2. Increased attraction for top-notch faculty and students
      3. Improved graduate programs
      4. Increased graduate student population

B. Economic benefits

1. Revenues generated by some ATDS programs

2. Increased market for Georgia Tech research capabilities

III. Industry's Benefits

A. Increased productivity

B. Improved production methods

C. Expansion into new product lines

HIGH TECHNOLOGY IN GEORGIA-1976

% OF GEORGIA MANUFACTURING EMPLOYMENT	.67%

HIGH TECHNOLOGY IN SANTA CLARA COUNTY, CALIFORNIA

% OF CALIFORNIA MANUFACTURING EMPLOYMENT	4.07%

HIGH TECHNOLOGY IN THE U.S.

% OF U.S. MANUFACTURING EMPLOYMENT	4.92%

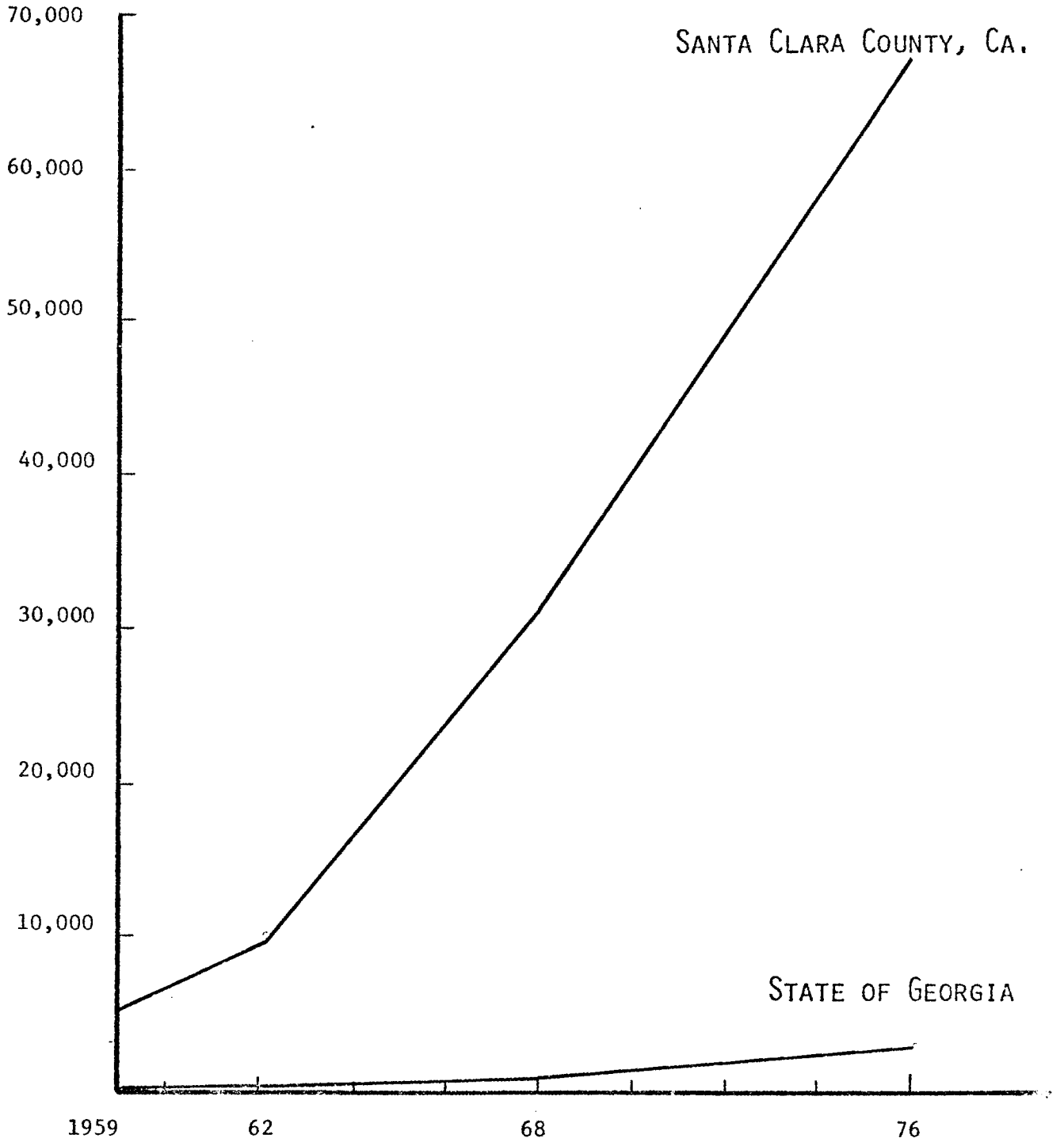
AVERAGE ANNUAL EARNINGS - 1979

TOTAL PRIVATE AVERAGE EARNINGS - U.S.	11,175
HIGH TECHNOLOGY AVERAGE EARNINGS - U.S.	13,168
% DIFFERENCE	17.8%

ATDS POTENTIAL

ASSUMING A SIMILAR GROWTH IN HIGH TECHNOLOGY EMPLOYMENT TO THAT OF SANTA CLARA COUNTY, CALIFORNIA DURING THE PERIOD 1968-1976, BY THE YEAR 2000 THE STATE OF GERGIA WOULD INCREASE DIRECT EMPLOYMENT IN HIGH TECHNOLOGY FROM ABOUT 2,600 TO 24,350.

HIGH TECHNOLOGY EMPLOYMENT



Funding Requirements and Options

Georgia Tech is seeking initial funding of $260,000 from the state (for FY 81) for the operation of the Advanced Technology Development Service program. In addition, $2,000,000 is sought for a one-time expense as the state's share for building an ATDS facility. It is anticipated that $3 million will be available from EDA to match the state's share. There may be a number of ways to fund this proposal. Two alternatives are the following:

OPTION 1: Fund the program ($260,000 FY 81; $500,000 amounts for the next 3-5 fiscal years) from general state appropriations. Georgia Tech would then have to utilize already crowded existing facilities.

OPTION 2: (a) Appropriate $260,000 for programs in FY 81; fund second year program at $500,000; subsequent years' programs would be funded with building revenues. See (b).

(b) Appropriate $2,000,000 through the supplemental budget to match federal funds for the ATDS facility.

Georgia Tech will establish an advisory board of private business leaders to be responsible for making the difficult decisions regarding which small businesses should and can be served. The advice of the Governor is sought regarding whether separate legislative authority for the ATDS should be obtained from the General Assembly.

EXECUTIVE SUMMARY

The state of Georgia has achieved a position of leadership in economic development by creating a positive relationship between government industry and by aggressively recruiting companies to lacate in the state. As the companies considering Georgia become more sophisticated, technical resources represented by Georgia Tech become more important. Recent locations such as Rockwell International and Northern Telecom have depended quite heavily on these resources. In order to continue the momentum of development and to steer growth toward higher technology, better paying, more environmentally attractive industry, it is proposed that an Advanced Technology Development Service be established at Georgia Tech. The program will embrace several elements directed to the creation of a high technology industrial base in Georgia.

In ATDS will focus simultaneously on several aspects of the advanced technology development problem. Work will be directed to:

(1) Development of an advanced technology entrepreneur community,

(2) Recruitment of domestic and foreign advanced technology companies,

(3) Assistance to existing Georgia industry for expansion into high technology product lines,

(4) Development of industries that can produce alternative energy products,

(5) Education of students, businessmen, and bankers in high technology venture development and management.

This program is ambitious, but builds on Georgia Tech's record of accomplishment and regional and national technical leadership base.

The first element of the ATDS will focus on the alleviation of entrepreneurial or small business problems to create a climate of growth that will attract high technology entrepreneurs to our area. In support of this thrust, efforts will

be devoted to educating the financial community to take advantage of high technology venture opportunities and to training students and businessmen as a means for assisting small business start-ups.

Alternate energy technologies will be a key target for new firm start-ups since Georgia Tech is a leader in solar and biomass fuels technology. Alternative energy technology may play a role similar to that of electronics in the Palo Alto area and act as a basis, though not a restriction, for a wide range of new companies.

As a separate but related program element, industrial recruitment activities directed toward both domestic and international firms will be expanded. Currently Georgia Tech has no formal program aimed at higher technology firms. Special needs of these kinds of firms are highly trained labor, special facilities, etc., and these will be addressed in this program unit.

The third primary work element will address the problem of finding ways for existing Georgia industry to expand into new high technology product opportunities. Businessmen will be kept abreast of new technologies through special seminars relating to business opportunities in new product lines and other similar kinds of technology update efforts.

The fifth ATDS element involves the education of students, businessmen, and financial community members in an effort to allow them to skillfully participate in advanced technology industries. This will be accomplished through entrepreneurship courses, technology update seminars, basic management short courses, and student participation in client firms and model firms.

The ATDS program will include the construction of the facility to house staff and to provide support to the entrepreneurial effort with "incubator" space. Construction of the facility will be undertaken with private, state, and federal grant funds.

Funding for programmatic aspects and administration will be requested through the regular Georgia Tech budget request. It is anticipated that the program can be initiated in FY-81 if initial planning is begun by January 1, 1980. Funding requirement for the planning effort is estimated to be $30,000. First year state fund requirements are estimated as $260,000 for the programmatic elements. The facility cost is estimated at $5,000,000 and it is anticipated that the private sector and the federal government would provide $3,000,000, and the state government would provide the remaining $2,000,000.

Introduction

Over the past several years an advanced technology development concept has been considered which would team the state government, Georgia Tech, and the private sector together in building and attracting new high technology industries to our state. The goal of the effort is to create a community of advanced technology companies in Georgia using the resources of Georgia Tech as a catalyst in their relocation or creation. Georgia Tech would (a) make available its considerable technical resources to foster entrepreneurial high technology development, (b) assist in stimulating relocation of domestic and foreign high technology firms to the state, (c) conduct a vigorous program of assistance to encourage expansion of existing industry into new high technology product lines, (d) develop new high technology alternate energy uses for our regional natural resources, and (e) educate students, businessmen, and financial community members in high technology venture development and management.

An initiative to implement this concept will require investment on the part of all involved but will return considerable benefits in the form of higher paying jobs and a more environmentally attractive state. Additionally it will provide balance and stability to our marketing and service oriented economy.

The State of Georgia is in a unique position to establish such a program and to attract high technology industries. The state is attractive from climatic, labor, and governmental attitude standpoints. It is a regional center for finance and marketing. Also, it has a strong higher education technology community centered around Georgia Tech with many different areas of expertise.

Capital funds for a building to be used to house the program are anticipated to be provided by the private sector, the federal government, and the state government. The Georgia Tech Research Institute will be asked to provide a major cash match and would retain title to the facility. Support for the programmatic aspects will be requested through the Georgia Tech budget allocation with a new administrative unit, reporting to the Vice President for Research, to be created to conduct day-to-day program activities.

The ATDS program would simultaneously benefit both the Engineering Experiment Station (EES) and the academic programs. This initiative would augment the EES program of applied contract research by creating a vehicle through which some of that research could be channeled into the market place. The academic programs would be supported by giving the teaching faculty new sources of graduate students and increased interaction with the "real" world of business.

Brief descriptions of the major programmatic elements along with a detailed facility plan are included below.

Narrative Program Description

Advanced Technology Development Service Program

In order to ensure that the ATDS program adresses the state's high technology economic development needs and that funds will be utilized wisely, many different program elements have been considered during the studies conducted over the past three years. Of these the following five have been identified as being most important:

(1) Advanced Technology Entrepreneur Development

(2) Advanced Technology Industrial Recruitment

(3) Aid to Existing Georgia Industry in Developing New High Technology Products

(4) New Technologies for Alternative Energy Supplies

(5) Education and New Technology Development

These programs are interrelated and mutually supportive. Each was selected because of its direct value to the high technology development process as understood by the team and involves concepts of proven value in high technology economic development of other regions of the U. S. Each of these five major elements were investigated and key program activities and projected budget levels were estimated. Each element and its relationship to the development process is described below.

1. Advanced Technology Entrepreneur Development

In the overall development process, the role of the entrepreneur cannot be overlooked, with advanced technology being proven to be the reservoir from which many major firms have been formed during the past thirty to forty years. The bay area of northern California is the best example of the benefits that can accrue from the marriage of new technology, electronics in that case, and the entrepreneur. Firms such as Hewlett-Packard, Inc., Varian Associates, Inc., and many others were a product of that union. H-P is now a $4 billion company employing over a thousand highly trained, highly paid workers in that area today. These firms in turn have been the spawning ground for many other small firms building on the local technology base that has developed.

Technology is not the only ingredient that is necessary for innovation and growth however. Money must be available and a local venture capital community must be created. In some instances this need may be provided from outside the area.

Local capital is essential, however, and can be provided through bank and venture institutions if a reliable technical resource offers consulting assistance in technical areas. Georgia Tech represents that force and will use its resources to stimulate private capital expenditures in local entrepreneurial activity and will work to educate the local private capital community regarding high technology investment opportunities.

In order to address the small high technology business opportunity adequately, it is proposed that an entrepreneurial assistance program be established which will accomplish the following:

(a) help entrepreneurs identify product markets,

(b) assist entrepreneurs in locating venture capital and assist venture, capitalists in locating and evaluating entrepreneurial opportunities.

(c) assist entrepreneurs in establishing business and business plans.

(d) provide low cost space and access to specialized resources and equipment on the Tech campus.

Incubator Space and Facilities Access

One major deterrent to entrepreneurial development today is access to sophisticated test equipment and appropriately outfitted facilities. To overcome this barrier a facility will be provided to support high technology firms during their early formative years and will act essentially as an "incubator." After the firm grows to a healthy level it will be encouraged to locate outside of the incubator but still near Georgia Tech. This space will have the basic amenities and will be directed to basic support of chemical, mechanical and electrical product development. Special facilities such as ventilation, chemically resistant drains, electric service, etc., will be provided in the structure.

The incubator space will be provided in a general purpose building to be constructed contiguous to the Georgia Tech campus. This building will include 90,000 square feet of space on three floors. The ground (first) floor will be

open bay type construction with a modular partition system capable of being subdivided into 2500 square foot modules. The second and third floors will be conventional office space and will ultimately house all elements of the ATDS program. In early stages, before the program fully develops, the second and third floors will be leased to other elements of the Georgia Tech community. The rents will assist in amortizing the cost of the building.

Entrepreneurs can benefit in several ways from being located in the incubator space contiguous to Georgia Tech. This allows access to facilities on campus such as the computer center, the library, and specialized labs. More importantly, perhaps, the entrepreneur could benefit from the people at Georgia Tech. This includes faculty members who can play important roles as consultants. A location proximate to Tech also provides a source of motivated and technically trained part-time help in the form of graduate students. Students can conveniently work part-time for a company in the incubaror facility while pursuing a graduate degree at Tech.

Incubator Facility Financing.

In order to be responsive to the needs of private firms, it is proposed that the construction of the incubator building be financed with private sector funds, and federal and state government funds. Efforts will be made to form a consortium of the Georgia Tech Research Institute, the Atlanta Economic Development Corporation, the State Office of Planning and Budget, and the U. S. Department of Commerce to raise construction funds. GTRI will be asked to provide a cash match of up to $250,000 to be used to acquire a grant from the U.S. DOC through the Economic Development Administration. The grant applicant would be the Atlanta Economic Development Corporation and the Office of Planning and Budget. Land for the building would be provided by the AEDC from urban redevelopment sources. Title of the land and building would revert to GTRI. Management will be provided by Georgia Tech.

2. Advanced Technology Industrial Recruitment

In addition to entrepreneurial development a second important method for improving our industrial base is through the more traditional industrial development activities of recruiting high technology companies to our area. Higher technology industrial candidates considering relocation to our area are becoming much more sensitive to the technology support climate and must see a positive effort to meet their special needs. This new requirement is evident with domestic firms, but more so with foreign firms wishing to locate in the U.S. A positive stance can be taken by putting Georgia Tech's resources to work in support of other traditional government economic development operations. Also, by providing direct access to Tech R&D activities to firms wishing to locate in the state, new product development activities, and, later, new manufacturing facilities might be located in the state.

In support of traditional industrial development activities, Georgia Tech would create a team of full-time professionals who would interface with domestic and foreign advanced technology industrial candidates in several specific ways. The team would:

(a) systematically identify new, high technology, industrial prospects;

(b) support other groups and agencies in the state in industrial recruitment with information to date;

(c) actively solicit high technology candidate's location in Georgia through visits, presentations, etc.

As an added element Georgia Tech would encourage high technology firms to locate R&D teams developing new products in the "incubator" building mentioned above. Proprietary research would be protected, but contract involvement of Georgia Tech faculty and staff would be encouraged. Also, use of sophisticated test equipment on a contract basis would be encouraged. In this way the sophisticated equipment available at Tech could be used to maximum advantage.

After product development has occurred, the pilot development and manufacturing operations would be encouraged to locate in Georgia and continuing interaction with Georgia Tech would be assured.

3. Aid to Existing Georgia Industry in Developing New High Technology Products

In addition to the effort to build technologically-based industry, a component of the Advanced Technology Development Service will be to stimulate the development of advanced technology product lines in existing companies. Such a course of action is important since approximately 70% to 80% of new jobs created are a result of the expansion of existing industries.

Although there is a broad program of aid to existing industry, it is primarily aimed at providing assistance to small and medium-sized companies, which are mostly labor-intensive. Often these companies are applying for assistance as a last resort--that is, the company's continued operation is in question.

The expertise and assistance required for the proposed effort to aid and stimulate investment in production of high technology products differs from this traditional thrust. More important, the benefit to the economy from the development of high technology companies would result in the demand for higher skilled labor and hence the development of the state's human capabilities and skills.

The aid to existing industry to encourage development of high technology products will cover a wide range of management and technical assistance. However, since new products are usually technically sophisticated, experts will be required to assist firms in their development activities.

Existing industry can benefit from a program designed to identify common technological problems and to find solutions to those problems. University personnel can also serve as technical consultants to individual firms which have specific and unique problems.

The identification of Georgia natural resources and development of commercial applications for those resources could be another important aspect of this element.

Technology transfer mechanisms would be necessary for disseminating the research findings from this work. This could be done through short courses and seminars as well as through the Georgia Tech Research Institute technology transfer magazine, the first issue of which is scheduled to be published in the fall of 1979. A periodic publication of on-going university research could also be advantageous to industry and would serve to promote the commercialization of university research results. This increases the possibilities for new product development.

4. New Technologies for Alternative Energy Supplies

In the development of other areas of high technology industry concentration, specific technologies have usually been involved. The Palo Alto area is highly dependent on electronics and silicon technology, while the Pittsburgh area is oriented strongly to minerals and coal technology. The Research Triangle area is more generally involved, but is strongly oriented to environmental technology development. Georgia Tech has many strengths but is especially competent in alternative energy technologies. Tech has the strongest solar thermal research and development program of any university in the country. National leadership is being acquired in the related field of biomass conversion, focusing on liquid transportation fuels, industrial energy systems, and residential systems. With the worsening world prospects for fossil energy supplies, these alternatives are becoming much more important and with careful treatment might provide the basis for a high technology industrial system in Georgia.

In order to address this emerging possibility it is proposed that a systematic program be established to encourage the creation of advanced alternative energy businesses and use of the incubator facility described above. Information developed for the public through state and federally sponsored research could be used to create products for the private sector.

As support to this effort it is proposed that a core team of Georgia Tech faculty and staff be selected to identify near term markets, assess market potential and economic constraints, and to assist entrepreneurs develop business plans to take advantage of these opportunities.

5. Education and New Technology Development

Associated with the main goals of the Advanced Technology Development Service are certain educational needs and opportunities, and it is important to address these in the set of activities to be conducted within the program. This program element addresses the key issue of providing technology firm managers and students preparing for careers in technology management with the tools and training to better perform their jobs. Described below are several specific issues which will be addressed by this element.

Technology Update

In order to provide a perspective on the prominent areas of technological development, it would be appropriate to conduct periodic short courses which constitute a "technology update". These would generally be offered with non-technical managers in mind, though they should be of broad interest. The purpose would be to provide a greater consciousness, among the entire community, of technological development and more specifically to provide directly relevant background and information for institutions and individuals who might have a role in the ATDS (e.g., bankers and other potential sources of venture capital). It would likely be appropriate to tailor specific courses to the needs of this latter group. It would be appropriate to include some detailed material on some case histroies taken from California's "Silicon Valley" or Boston's Beltway.

Courses in Entrepreneurship

It would be appropriate to develop short courses in entrepreneurship under the auspices of the ATDS. This activity would be in direct support of the

entrepreneurial development activity (1) above. The primary focus, of course, would be starting new businesses in the area of high technology. Such a course, or courses, could be a spin-off from regular academic courses developed in the College of Industrial Management at Georgia Tech. In addition, the possibility exists that client firms of the ATDS could serve as live "case studies" for such courses in the I.M. College. Going one step further, some of the client firms could be well served by student teams serving as management consultants. Small or newly created firms have many needs which could be satisfied by students (graduate and undergraduate) in the College of Industrial Management, and working with these firms under appropriate supervision can provide a very meaningful educational experience for the students. This is very closely related to the concept of the Small Business Institute (SBI) program of the Small Business Administration.

The Basic Management Short Courses

In order to assist the managers of fledgling firms develop some capability for the management of their company, special short courses dealing with the basics of small business management could be provided. Because the entrepreneur in a new high technology venture is likely to be an engineer or scientist, there usually is considerable need for some education in the basics of managing a business. Topics would include all the basic functions of the business, such as finance and accounting, production and marketing, as well as some basics of personnel management.

A "Model" Firm

Consideration might be given to utilizing the "incubator" setting for establishing and running a "model firm". The entire activity would be run by graduate students of Georgia Tech, mostly from the College of Industrial Management. There would be a formal tie-in to the academic programs of the College and perhaps it would constitute a credit earning activity; a likely possibility

would be a project activity associated with a course in entrepreneurship. All of the planning and management of the startup process would be conducted by the students, including the securing of venture capital. With some guidance and supervision, this entire activity could serve as a model for other real or potential firms.

Management Plan

The Advanced Technology Development Service will report administratively to the Office of the Vice President for Research at Georgia Tech. This will ensure that the program receives attention at the highest operating level and has contact with all R&D projects at Georgia Tech. The program will be managed by a senior staff member who will be provided with support services from all elements of the Institute. Each major program element will be managed by an experienced coordinator who will be responsible for coordination with appropriate state agencies and for performance of this respective unit.

In order to ensure coordination between the ATDS and appropriate state agency and private sector representatives, it is proposed that an advisory committee be established with appointments to be made by the Governor. The function of this committee would be to provide general guidance to the ATDS program in the form of goals and objectives and to act as an interface with the local private sector financial and business community.

An organization chart for the ATDS is shown in Figure 1.

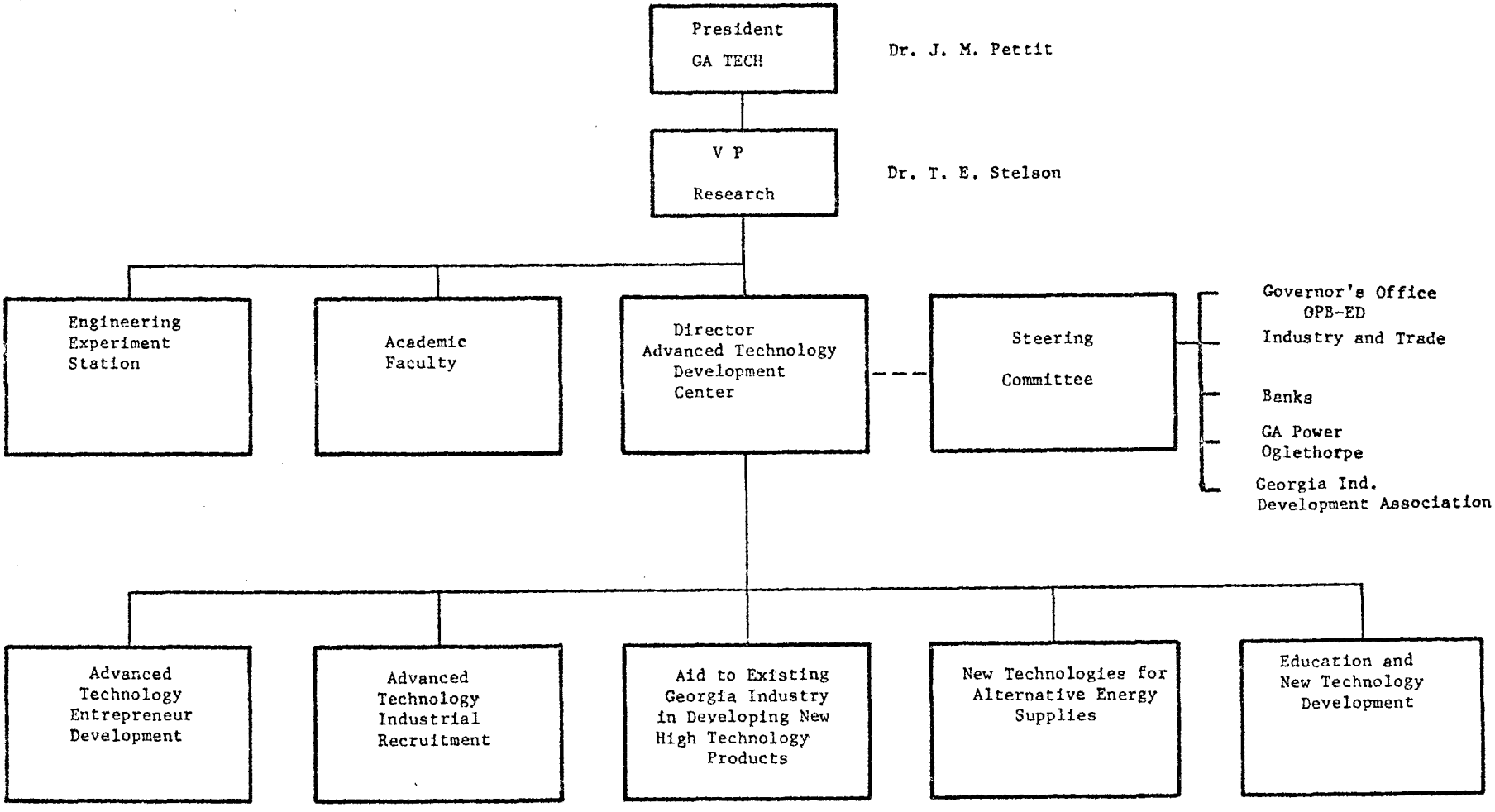


Figure 1. Advanced Technology Development
Service Organization Chart

Budget Plan

The Advanced Technology Development Service includes two primary components--Development Programs and a Facility. As noted above, facility construction funds will be sought from private and federal and state government sources. Specifically, a separate proposal will be developed jointly by Georgia Tech, the Office of Planning and Budget, and the Atlanta Economic Development Corporation describing the facility requirements. The facility will include both general purpose space, to be used as incubator space for small businesses, and office space for use by ATDS staff, R&D teams from industry, and, initially, elements of the Georgia Tech faculty. A proposal will be submitted to the private sector, including the Georgia Tech Research Institute, and the Economic Development Administration, U.S. Department of Commerce, and the state government.

Regular program funds will be requested through the zero base budget of Georgia Tech. The program is envisioned to develop in three definitive stages on a time frame beginning January 1, 1980. The first six months will be devoted to developing a detailed program plan. The planning effort is expected to require $30,000 and will be requested from the Governor's Office. With regular funding beginning in July 1, 1980 (FY-80) of $260,000, work will begin with staff recruitment, data base development, initial company contacts, and entrepreneurial assistance. In FY-81 the program would be expanded to its full level of effort at $500,000 per year. Completion of the facility would occur in FY-80 with occupancy slated for July 1, 1981. Outlined below are the major programmatic activities described in the narrative above with budget requirements listed by activity.

I. Administration - FY-81 $50,000

A. Program Management

B. Budget and Personnel

C. Secretarial Support

II. Advanced Technology Entrepreneur Development - FY-81 $40,000

A. Educate the venture capital and financial community

1. Present seminars conducted by Georgia Tech staff and consultants

2. Offer courses in entrepreneurship and venture management

B. Assist in marketing and economic planning

1. Evaluate potential markets

2. Assist in business plan development

3. Conduct preliminary manufacturing cost studies

C. Assist in entrepreneur-venture capital liaison

1. Assist entrepreneurs in developing relationships with venture capitalists

2. Objectively evaluate entrepreneurial concepts for local capital sources

D. Assist in business formation

1. Provide assistance and guidance in business structure

2. Assist in preparing business proposal packages

3. Aid in obtaining capital funds

E. Provide facilities and support for entrepreneurs

1. Provide low cost space

2. Provide access to specialized equipment and information sources

3. Supply faculty consultants and part-time graduate student employment

III. Advanced Technology Industrial Recruitment - FY-81 $50,000

A. Identification of industrial prospects

1. New plant locations

2. R&D satellite groups

B. Coordinated effort with other industrial recruitment groups

1. Information and data exchange

2. Cooperative efforts to provide an attractive environment for industry

3. Relocation services

C. Access to Georgia Tech facilities

1. Technical library, computer facilities, and laboratory equipment

2. Incubator buildings

3. Faculty consultants

4. Graduate study opportunities

5. Graduate student employment

D. Research opportunities solicitation

1. Cooperative research

2. Contracted research

E. Direct recruitment efforts

1. Invitations for campus visits

2. Presentations to prospects

F. International industry recruitment

1. Technical resource data base

2. Coordination with Industry and Trade foreign offices

IV. Aid to Existing Georgia Industry in Developing New High Technology Products - FY-81 $50,000

A. Technical and management assistance

1. Common problem identification and solution

2. Individual firm consultation services

B. Georgia resource utilization

1. Identification of resources

2. Development of commercial applications

C. Technology transfer

1. Workshops and short courses

2. Technology transfer magazine

3. Publication of on-going university research

D. New product opportunities

V. New Technologies for Alternative Energy Supplies - FY-81 $30,000

A. Identification of potential commercial applications of energy research results

B. Evaluation of potential commercial applications

1. Market assessment

2. Economic studies

C. Technology transfer of university energy research

1. Publications

2. Seminars

D. Entrepreneur development

1. Incubator building

2. Technical assistance

E. Funding assistance

1. Identify potential funding sources

2. Assist in obtaining capital funds

VI. Education and New Technology Development - FY-81 $40,000

A. Technology update short courses

1. New technological developments

2. Case histories from other advanced technology centers

B. Entrepreneurship education

1. Academic courses in the I.M. school

2. Student participation in client firms

C. Basic management short courses

   1. Finance and accounting

   2. Marketing

   3. Management

D. Student organized and administered model firm

Appendix III

Additional Interviews

Meeting with Mr. Ken Willis

Mr. Ken Willis has had extensive experience with a number of organizations involved in the evaluation and commercialization of new products. He was involved for thirteen years with the British National Research Development Corporation (NRDC), a government agency set up in 1948 to promote and finance the development of inventions and innovation in the United Kingdom. Following this, Mr. Willis advised the State of Connecticut in 1972 on the establishment and design of the Connecticut Product Development Corporation, an organization similar to NRDC, but dealing specifically with new products. He was retained to set up and administer the agency while acting as its president. Today Mr. Willis is actively advising other states on the structure and viability of bodies like CPDC.

The British National Research Development Corporation was established after World War II to stimulate the economy and took 15 years to become profitable. The majority of the work consists of joint projects with industry with most of the revenue provided by patents. Approximately 60% of the income is attributed to only four patents.

The CPDC seeks to fund new product development rather than inventions and innovations and strives for a return in the way of new jobs and revenues in a relatively short time. It does not deal with start-up companies or private inventors without a company. To date, the CPDC has funded about 20 companies with a total of $1 million and has received about $80,000 in royalties. The CPDC takes no equity in a company, but seeks five times the invested amount back through payments of 5% royalty on sales. Once this return is realized, continued royalties for the life of the company amount to 1/2%. If the product is a failure, no return on the investment is received. The CPDC typically invests 60% of product development costs and these investments have generally ranged from about $20,000 to $30,000.

The interview with Mr. Willis emphasized the importance of an available fund of seed money for financing new product developments of independent entrepreneurs or of expanding industries. The CPDC was able to finance its activities through the issuance of state bonds to the amount of $10 million.

Meeting with Mr. Brian Haslett

Mr. Brian Haslett, a member of the core team of the Venture Founder's Corporation (VF), was in Atlanta in August and discussed his experiences in the venture capital field with the SSET team and other interested persons. Mr. Haslett is presently working to develop a pool of venture capital in the Atlanta area.

The meeting with Mr. Haslett highlighted the process which VF uses to evaluate venture investment opportunities. Six-day workshops, spread over three weekends, are held to assist entrepreneurs and venture capital investors to develop and assess business proposals and the management team that will implement them. The workshops aim to perform the following three steps:

1) test the commitment and motivation of entrepreneurs

2) teach the successful way to build a management team

3) analyze ventures and develop business plans.

A venture which is favorably evaluated is provided further aid to develop a plan and obtain venture capital.

Appendix IV

Economic Impact of the ATDS

Appendix IV

Data for high technology employment in Georgia (high technology groups #2 and #4) as of 1976 were compiled from the County Business Patterns. This was found to total 3,172, of which 2755 was attributed to group #2 and 417 to group #4. The most conservative estimate of past employment growth for professional and technical occupations was then applied to this total in order to arrive at an estimate of high technology employment in Georgia for 1980. This growth assumption of 2.31% annually resulted in a high technology employment estimate of 3475 for 1980, which was then considered within two scenarios.

First, growth in high technology employment without the ATDS was estimated for each year until the year 2000, under the same conservative assumption of 2.31% growth. In the same manner, growth in the presence of the ATDS was calculated assuming an approximate 10% annual growth in high technology employment, which is comparable to the growth of high technology electronics employment in Santa Clara County, California from 1968 to 1976. The difference constitutes the direct employment effect of the ATDS which is depicted in Table 1.

Given the direct employment effect of the ATDS, three multiplier assumptions are applied in order to assess total jobs created, direct and indirect. These three scenarios for total employment created from the ATDS may be seen in Table 2. The scenarios are broken down further into direct and indirect jobs created from the ATDS in Table 3. This distinction makes possible the determination of total potential impact of the ATDS given that high technology positions demand higher than average salaries.

In order to calculate the total potential impact, corresponding estimates for future wages and salaries in Georgia are shown in Table 4. Average monthly earnings for the U.S. were taken from Employment and Earnings, Bureau of Labor Statistics. Wages and salaries for high technology employment were tabulated for the SIC codes previously designated. These figures were then scaled to yield estimates of wages

and salaries in general and for high technology employment in Georgia. An annual growth assumption of 7.5% was then applied to these calculations for each year until the year 2000.

Given the estimates for direct and potential indirect employment impact of the ATDS, in addition to the corresponding wage and salary estimates for high technology employment and general employment, Table 5 shows total impact under the three multiplier assumptions. Total impact for each year consists of the number of jobs created directly by the ATDS at the rate of high technology wages and salaries, and jobs created indirectly from the presence of the ATDS applied to general wages and salaries.

Table 1

Employment Impact of ATDS In Georgia

	High Technology Employment without ATDS assuming 2.3% Growth	High Technology Employment with ATDS Assuming 10.1 Growth	Difference Direct Employment due to ATDS
1980	3475	3475	0
	3555	3826	271
	3637	4212	575
	3721	4637	916
	3807	5105	1298
1985	3895	5620	1725
	3985	6187	2202
	4077	6811	2734
	4171	7498	3327
	4267	8254	3987
1990	4366	9087	4721
	4467	10004	5537
	4570	11013	6443
	4676	12124	7448
	4784	13347	8563
1995	4895	14694	9796
	5008	16176	11168
	5124	17808	12684
	5242	19605	14363
	5363	21583	16220
00	5487	23760	18273

Table 2

Total Jobs Created Using Different Multiplier Assumptions

1980	2.0	2.5	3.0
	542	677.5	813
	1150	1437.5	1725
	1832	2290	2748
	2596	3245	3894
1985	3450	4312.5	5175
	4404	5505	6606
	5468	6835	8202
	6654	8317.5	9981
	7974	9967.5	11961
1990	9442	11802.5	14163
	11074	13842.5	16611
	12886	16107.5	19329
	14896	18620	22344
	17126	21407.5	25689
1995	19592	24490	29388
	22336	27920	33504
	25368	31710	38052
	28726	35907.5	43089
	32440	40550	48660
2000	36546	45682.5	54819

Table 3

Total Jobs Located -- Direct and Indirect

	2.0		2.5		3.0	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
1980						
	271	271	271	406.5	271	542
	575	575	575	862.5	575	1150
	916	916	916	1374	916	1832
	1298	1298	1298	1974	1298	2596
1985	1725	1725	1725	2587.5	1725	3450
	2202	2202	2202	3303	2202	4404
	2734	2734	2734	4101	2734	5468
	3327	3327	3327	4990.5	3327	6654
	3987	3987	3987	5980.5	3987	7974
1990	4721	4721	4721	7081.5	4721	9442
	5537	5537	5537	8305.5	5537	11074
	6443	6443	6443	9664.5	6443	12886
	7448	7448	7448	11172	7448	14896
	8563	8563	8563	12844.5	8563	17126
1995	9796	9796	9796	14694	9796	19592
	11168	11168	11168	16752	11168	22336
	12684	12684	12684	19026	12684	25368
	14363	14363	14363	21544.5	14363	28726
	16220	16220	16220	24330	16220	32440
2000	18273	18273	18273	27409.5	18273	36546

Table 4

Wage and Salary Increases in Georgia

Current Average Yearly Wages for the U.S. (1979):

Total	High Technology
$11,175	$13,168

These amounts were multiplied by the ratio of Georgia to the U.S. in regard to Total Personal Income per employee (Survey of Current Business, 1st quarter, 1979) to arrive at an approximation of the current average wages in Georgia.

	Total	High Technology
1979	$ 9,629	$11,347

These amounts were then tabulated assuming a 7.5% annual growth which includes 6% for long term inflation and 1.5% due to real income gain.

1980	$10,351.175	$12,198.025
	11,127.513	13,112.877
	11,962.077	14,096.343
	12,859.232	15,153.568
	13,823.675	16,290.086
1985	14,860.45	17,511.842
	15,974.984	18,825.231
	17,173.108	20,237.123
	18,461.091	21,754.907
	19,845.673	23,386.525
1990	21,334.098	25,140.515
	22,934.156	27,026.053
	24,654.217	29,053 007
	26,503.284	31,231.983
	28,491.03	33,574.381
1995	30,627.857	36,092.46
	32,924.947	38,799.394
	35,394.318	41,709.349
	38,048.991	44,837.55
	40,902.558	48,200.366
2000	43,970.25	51,815.394

Table 5

Total Income Impact of ATDS Under Multiplier Assumptions

2.0 Multiplier Assumption

	Direct	Indirect	Total
1980			
	$ 3,553,590	$ 3,015,556	$ 6,569,146
	8,105,397	6,878,194	14,983,591
	13,880,668	11,779,057	25,659,725
	21,144,532	17,943,130	39,087,662
1985	30,207,927	25,634,276	55,842,203
	41,453,159	35,176,915	76,630,074
	55,328,294	46,951,277	102,279,571
	72,378,576	61,420,050	133,798,626
	93,242,075	79,124,690	172,366,765
1990	118,688,370	100,718,280	219,406,650
	149,643,260	126,986,420	276,629,680
	187,188,520	158,847,120	346,035,640
	232,615,810	197,396,460	430,012,270
	287,497,420	243,968,690	531,466,110
1995	353,561,740	300,030,490	653,592,230
	433,311,630	367,705,810	801,017,440
	529,041,380	448,941,530	977,982,910
	644,001,730	546,497,660	1,190,499,390
	781,809,940	663,439,490	1,445,249,430
2000	946,815,500	803,468,380	1,750,283,880

Table 5 -- continued

2.5 Multiplier Assumption

	Direct	Indirect	Total
1980			
	$ 3,553,590	$ 4,523,334	$ 8,076,924
	8,105,397	10,317,231	18,422,628
	13,880,668	17,668,586	31,549,254
	21,144,532	26,914,695	48,059,227
1985	30,207,927	38,451,414	68,659,341
	41,453,159	52,765,373	94,218,532
	55,328,294	70,426,916	125,755,210
	72,378,576	92,130,075	164,508,651
	93,242,075	118,687,040	211,929,115
1990	118,688,370	151,077,420	269,765,790
	149,643,260	190,479,630	340,122,890
	187,188,520	238,270,680	425,448,200
	232,615,810	296,094,690	528,710,500
	287,497,420	365,953,040	653,450,460
1995	353,561,740	450,045,740	803,607,480
	433,311,630	551,558,720	984,870,350
	529,041,380	673,412,300	1,202,453,680
	644,001,730	819,746,490	1,463,748,220
	781,809,940	995,159,240	1,776,969,180
2000	946,815,500	1,205,202,600	2,152,018,100

Table 5 -- continued

3.0 Multiplier Assumption

	Direct	Indirect	Total
1980			
	$ 3,553,590	$ 6,031,112	$ 9,584,702
	8,105,397	13,756,388	21,861,785
	13,880,668	23,558,114	37,438,782
	21,144,532	35,886,260	57,030,792
1985	30,207,927	51,268,552	81,476,479
	41,453,159	70,353,830	111,806,989
	55,328,294	93,902,554	149,230,848
	72,378,576	122,840,100	195,218,676
	93,242,075	158,249,380	251,491,455
1990	118,688,370	201,436,560	320,124,930
	149,643,260	253,972,840	403,616,100
	187,188,520	317,694,240	504,882,760
	232,615,810	394,792,920	627,408,730
	287,497,420	487,937,380	775,434,800
1995	353,561,740	600,060,980	953,622,720
	433,311,630	735,411,620	1,168,723,250
	529,041,380	897,883,060	1,426,924,440
	644,001,730	1,092,995,320	1,736,997,050
	781,809,940	1,326,878,980	2,108,688,920
2000	946,815,500	1,606,937,760	2,553,753,260